SEPTEMBER, 1934.

GENERAL PHYSICS.

ADSORPTION.

3448. Validity of the Langmuir Adsorption Isotherm when Forces Exist between the Adsorbed Molecules. G. Damköhler. *Zeits. f. phys. Chem.* 169. *Abt.A.* 1–2. *pp.* 120–128, 1934.—By taking into account the forces which must exist between molecules adsorbed at a surface the author develops the Langmuir adsorption isotherm in the form $N = abp/(1 + bCp)$. C is a factor which accounts for the forces existing between molecules. Since C is a function of the temperature it is suggested that it provides an explanation of the variation of the adsorption saturation maximum with temperature. F. J. W.

3449. Heat of Adsorption of Hydrogen on Tungsten. J. K. Roberts. *Cambridge Phil. Soc., Proc.* 30. *pp.* 376–379, *July* 30, 1934.—A method is described for measuring the heat of adsorption of hydrogen on a clean tungsten filament. The value obtained is $2 \cdot 8 \times 10^4$ cal./mol. AUTHOR.

3450. Adsorption of Hydrogen Chloride on Potassium Chloride. R. Bradley. *Faraday Soc., Trans.* 30. *pp.* 587–596, *Aug.,* 1934.—The adsorption of HCl on KCl was measured by means of a torsion microbalance, and conforms to the equation for slow diffusion into finite cracks. The energy of activation is 7090 cal./mol. and corresponds to the adsorption energy calculated for a HCl molecule in the surface field of the crystal. AUTHOR.

ATOMIC AND MOLECULAR STRUCTURE.

3451. Structure of Atomic Nuclei. H. J. Walke. *Phil. Mag.* 18. *pp.* 129–155, *May,* 1934.—The paper extends ideas referred to in previous papers [see Abstracts 2256 and 2823 (1934)] to disintegrations by α-particle bombardment and shows that in the nuclei there exist no " free " protons but that they are bound either as diplons or α-particles, the neutrons being less firmly bound. An explanation of all the disintegrations by α-particle bombardment is given. The emission of protons is explained by the formation of pairs of electrons, the positive electron uniting with the neutron to produce a proton. In the case of nuclei containing a proton and neutrons, one neutron and the proton form a diplon, which is stable under α-particle bombardment, the other neutron being emitted in the form of a disintegration proton. The reactions for proton emission are given for such nuclei, and these same reactions, on certain assumptions regarding α-particle energy, allow also for neutron and positron emission. In discussing α-particle groups in nuclei it is shown that the assumption that the 3α group is a very stable sub-nuclear unit accounts for the radioactivity of K and Rb and also explains the rarity of the inert gases. The paper contains further sections on the stability and abundance of atoms, α-particle shells in the nucleus and the origin of the elements and cosmic radiation. [See following Abstract.] W. E. P.

3452. Radioactivity of Light Elements. H. J. Walke. *Phil. Mag.* 18. *pp.* 156–164, *July,* 1934.—It is shown that the induced radioactivity of Al, Mg and Bo under bombardment by α-particles may be explained on the hypothesis suggested in a previous paper [see preceding Abstract], it being further assumed that the radioactivity is due to the formation within the new nuclei of a proton with excess energy [radio-proton]. In considering experimental results, it is shown that it is unlikely that disintegration of the bombarding α-particles occurs. The reactions obtained by diplon bombardment are discussed in connection with the possibility of the disintegration of the diplon, the " radio-proton " and the formation of electron pairs. W. E. P.

3453. Empirical Limits of Stability of Atomic Nuclei. G. Gamow. *Zeits. f. Physik,* 89. 9–10. *pp.* 592–596, *June* 24, 1934.—The existence and stability of the various types of nuclei, in particular of isobares, enable the author to make deductions about the functional relationship between the nuclear binding energy and the ratios of the nuclear neutrons to the nuclear protons. The law of minimum energy is found to be expressed by a curve with seven to eight bends, which may be related to the anomalies that occur in the energies involved in α-ray transformations. H. L. B.

3454. Binding Energies in the Radioactive Families Uranium-Radium and Thorium. W. M. Elsasser. *Comptes Rendus,* 199. *pp.* 46–48, *July* 2, 1934.—The energies of disintegration (not of binding owing to doubt as to the mass of the neutron) of the isotopes of elements 82, 84, 86, 88, 90, and 92 have been calculated from available data, and plotted against the numbers of protons and neutrons assumed to be present in the various nuclei. C. A. S.

3455. Nuclear Physics. H. Hulubei. *Comptes Rendus,* 199. *pp.* 199–201, *July* 16, 1934.—The author describes the technique employed in using hydrogenated Pd for the production of protons thereby considerably simplifying the experimental procedure necessary for certain transmutations. The method is capable of producing a source of protons equal to or exceeding that of any previously described. The maximum yield obtained by the author is 750 μA for 1 hr., but he has reason to believe that this could be still further increased. He describes two series of experiments, the one with fields of 200–1200 V/cm. and the other with fields of 100,000–200,000 V/cm., in which the wall of a tube of Pd, suitably heated, separates the space in which the ions are produced and accelerated, from a reservoir of hydrogen fed by the aid of an osmo-regulator of ordinary or electrolytic Pd. This new technique can also be extended to the production of deutons. R. L.

3456. Energy Distribution between Disintegration Products of Boron. A. D. Fokker, H. D. Kloosterman and F. J. Belinfante. *Physica,* 1. *pp.* 705–714, *June,* 1934. *In English.*—When a proton is absorbed by B^{11}_5 a disintegration results in which three α-particles are emitted and Rutherford and Oliphant [see Abstract 4042 (1933)] have published curves showing the relation between the number of α-particles and their range. The present paper is concerned with two attempts to deduce the form of these curves theoretically. The calculations, which are based upon classical dynamics, lead to the conclusion that particles having about half the energy of the fastest are much more frequent than would be expected. J. E. R. C.

3457. Protons Excited from Al by α-Particles of 7-cm. Range. G. Ortner and G. Stetter. *Zeits. f. Physik*, 89. 11–12. *pp.* 708–712, *July* 13, 1934.—Using RaB + C as a source of α-particles and special technique to minimise the effects of the accompanying β- and γ-radiation, an examination is made of the disintegration products of Al. Four groups of protons, of ranges 24, 38, 57 and 89 cm. are reported, the corresponding energy emissions being in agreement with those reported by Haxel. J. E. R. C.

3458. New Disintegration Produced by Neutrons. J. Chadwick, N. Feather and W. T. Davies. *Cambridge Phil. Soc., Proc.* 30. *pp.* 357–364, *July* 30, 1934.—In this paper a new type of disintegration, *viz.*, one in which a carbon nucleus gave rise to three particles is reported. The disintegration was observed during a series of expansion chamber experiments. Two explanations are offered: (1) that it results from a non-capture disintegration; $C_{12} \rightarrow 3\,He_4$ or (2) that it results from a capture disintegration; $C_{12} + n^1 \rightarrow 2\,He_4 + He_5$. There appears to be no method available at present for distinguishing between these reactions. J. E. R. C.

3459. Frequency Numbers of the Isotopes of Chemical Elements. W. Yen. *Comptes Rendus*, 199. *pp.* 62–63, *July* 2, 1934.—The paper consists of a discussion of the frequency numbers of the isotopes and the relationship to the number of isotopes of each element. The various discrepancies between the known and theoretically possible isotopes is pointed out. For details the paper must be consulted. F. J. B.

3460. Heavy Hydrogen—A New Research Tool. H. S. Taylor. *Frank. Inst., J.* 218. *pp.* 1–28, *July*, 1934.—A general survey of the preparation and properties of $H^2{}_2O$, the analysis of mixtures containing $H^2{}_2$, methods of concentration, the significance of the $H_2 \rightarrow H^2{}_2$ equilibrium in surface catalysis, the possible replacement of H by H^2 in compounds, illustrated by ammonia, the use of H^2 as a bombarding ion in atomic transmutations and the mechanism of reaction. N. M. B.

3461. Electrolytic Concentration of the Heavy Hydrogen Isotope in Water. L. Tronstad and J. Brun. *Zeits. f. Elektrochem.* 40. *pp.* 556–558, *Aug.*, 1934.—The electrolytic concentration of D_2O in H_2SO_4 solution in which lead electrodes were employed, led to poor yields owing to the formation of spongy lead at the kathodes. The spongy lead caused the passage of fresh electrolyte to the kathode to be difficult; and thereby reduced the current density. Smooth lead electrodes and low current densities showed as good separation effects as iron and nickel in alkaline solutions at higher current densities. For the technical preparation of concentrated D_2O, the use of alkaline solution was preferable. F. J. B.

3462. Complex Neutron. H. Margenau. *Phys. Rev.* 46. *pp.* 107–110, *July* 15, 1934.—The consequences of the assumption that the neutron be a combination of a proton and an electron, with a modified potential near the proton, are worked out on the basis of Schrödinger's and of Dirac's theory. Various features of such a model are discussed, and its unsatisfactory properties are exhibited. AUTHOR.

3463. Shape of Fibre-Forming Molecules in Solutions. W. Kuhn. *Kolloid Zeits.* 68. *pp.* 2–15, *July*, 1934.—Statistical considerations are advanced concerning the form which chain-forming molecules suspended in a solution (or in a gas volume) can assume in consequence of valence angles and free rotatability. The relationships obtained are valid also, with slight alterations in the respective constants, for the cases of limited rotatability and variable valence angles. A particularly probable external limit of the irregular convoluted fibre-molecule is that of a strongly strained ellipsoid whose axes are in the ratio of about 6 : 2–3 : 1. If during construction of the coil, the intrinsic volumes of the separate parts of the fibre be neglected, a coil volume is obtained which increases proportionally to $\sqrt{z}$ (where z = the number of chain terms), and therewith a specific viscosity arises which likewise increases proportionally to $\sqrt{z}$ [see also Abstract 2122 (1933)]. The consideration of the volumes required by the separate fibre parts gives, however, an extension of the coil, which the linear growth of viscosity with the term number z explains at least in part if not entirely. Experiments on the formation-velocity of rings of higher term number afford evidence of an appreciable extension of the coil bound up with decreased diffusion velocity of the coil components within the coil. It is shown that the coiled fibre molecule may give rise to a special double refraction in such a way that it may be perceptible for low molecular products, but vanishingly small for high molecular products. H. H. Ho.

3464. Molecule Planning. W. H. Bragg. *Faraday Soc., Trans.* 30. *pp.* 665–673, *Aug.*, 1934. *Spiers Memorial Lecture.*—The development of X-ray analysis of crystal structure following Laue's classical experiments is briefly surveyed, leading to a description of the various stages of "molecule planning," or the determination of electron density as a function of position in space. The interpretation of X-ray diffraction pattern photographs is possible on an infinite number of arrangements of electron density, and, in the absence of direct knowledge of the relative positions of the various sets of density planes, use is made of the centre of symmetry of the crystal, known unit-cell magnitudes, and chemical considerations. It is finally possible to calculate the electron density at any point from the observed positions and intensities of the diffraction figure. Illustrations are given for tetramethylbenzene. N. M. B.

3465. Stability of the Benzene Ring and Related Compounds. W. G. Penney. *Roy. Soc., Proc.* 146. *pp.* 223–238, *Aug.* 1, 1934.—It is shown that the resonance between the p_n electrons does not select benzene as the most stable of the single-ring structures $(CH)_n$; but that the binding energy of the other three bonds on each carbon nucleus does. The calculations are based on the well-known formula of perfect pairing, with directed wave functions for the C-C and C-H bonds. The energy of the ring $(CH)_n$ is evaluated in terms of n and certain exchange integrals. It is found that $n = 6$ is the most stable ring over wide ranges in the exchange integrals, and this is interpreted to mean that the H atoms can be replaced by any monovalent group with little change in the form and stability of the ring. Improving the calculations by putting in some terms previously omitted does not affect the result that benzene is the most stable ring. The ring nearest in stability to benzene is $n = 8$ (cyclo-octatetrene). The calculations indicate that this compound is probably slightly buckled out of the plane. One would expect cyclo-octatetrene to hydrogenate very easily, and in fact, it does. The calculations can be extended to the ring compounds $(CH_2)_n$. One finds that any value of n greater than 2 can give a ring, but that $n = 3$ and 4 should be rather unstable. Rings $n = 3, 4$ and 5 should have the C atoms coplanar, but rings $n = 6, 7, \ldots$, should be buckled. These conclusions are borne out by the observed stereo-isomerism and by X-ray and electron diffraction measurements. [See Abstracts 4720 (1933) and 2106 (1934).] AUTHOR.

3466. Quantum Mechanics of Unsaturated and Aromatic Molecules. G. W. Wheland. *J. Chem. Phys.* 2. *pp.* 474–481, *Aug.*, 1934.—A comparison is made of two quantum-mechanical methods of treatment of unsaturated and aromatic organic molecules. The Heitler-London-Slater-Pauling treatment, which is based upon the use of Slater valence-bond eigenfunctions, seems to give results in somewhat better general agreement with experiment than the Hund-Mulliken-Hückel, which is based upon the use of molecular orbitals of the Hund-Mulliken type. The latter, however, can be extended to a wider variety of problems. The problems considered include the energy relations among hydrocarbons, the dissociation of aryl substituted ethanes, the electron-affinity of free radicals and the acid strength of hydrocarbons. AUTHOR.

3467. Wave-Mechanical Treatment of the Napthalene Molecule. J. Sherman. *J. Chem. Phys.* 2. *pp.* 488–491, *Aug.*, 1934.—The secular equation corresponding to the forty-two canonical structures for napthalene has been set up and solved rigorously (except for the neglect of certain exchange integrals), the energy value obtained being $2 \cdot 0400\alpha$ greater than that corresponding to one of the unexcited structures, in which α is the single exchange integral between adjacent carbon atoms. The equation has also been solved by various simplified procedures, and it has been found that the assumptions made in the earlier treatment of Pauling and Wheland [see Abstract 3288 (1933)] are to a considerable extent justified. The coefficients of the various structures in the wave function for the normal state have been evaluated. It has been found that of the three unexcited structures the symmetrical one makes approximately a 50 % greater contribution to the wave function than either of the two unsymmetrical structures. Some further discussion of the magnitudes of the coefficients is given. AUTHOR.

3468. Structure of Hydrogen Peroxide and Hydrazine. W. G. Penney and G. B. B. M. Sutherland. *J. Chem. Phys.* 2. *pp.* 492–498, *Aug.*, 1934.—The method of electron pairs has been applied to determine the most stable configuration for the atoms in the molecules $HO - OH$ and $H_2N - NH_2$. The calculations show that free rotation cannot occur in either of these molecules at ordinary temperatures and that the only stable forms are those in which the azimuth of one-half of the molecule with respect to the other is approximately 90°. The essential feature of the argument is that the electrons of the two central atoms arrange themselves to form the strongest possible bonds and in so doing render the charge density on these atoms unsymmetrical about the axis of the molecule. The interaction of the two electronic clouds is the dominant factor in determining the azimuth of one group relative to the other; all other types of interaction have been estimated to shift the equilibrium position only slightly, *i.e.*, probably from 90° to 100°. AUTHORS.

See also Abstracts 3504, 3639, 3643, 3647, 3649, 3650, 3657, 3659, 3671, 3697, 3705, 3706, 3711, 3721, 3722, 3723, 3727, 3738, 3742, 3744, 3824, 3858, 3881, 3896, 3902, 3904, 3907.

COLLOIDS.

3469. Lyophilic Colloids. S. M. Liepatoff. *Kolloid Zeits.* 68. *pp.* 55–60, *July*, 1934.—Acetyl cellulose, which is insoluble in chloroform, may be dissolved via the adsorption of soluble fractions, and this solubility increases with the solubility of the peptisation agent used. An adsorption equilibrium exists between the soluble and insoluble fractions, and this fact explains to a large degree the solid phase rule of Ostwald as applied to lyophilic colloids. The mechanism of colloidal solution is found to depend on two conditions: (1) intensity (energy) of the attraction of the molecules or micelles for each other (aggregation factor); (2) intensity (energy) of the reciprocal effect between the peptisation agent and the surface of the micelle of the substance to be dispersed (dispersion factor). These two conditions are responsible for the entire variety in behaviour of different substances. H. H. Ho.

3470. Anodic Depression in Electrolysis of Gelatin. J. Swyngedauw. *Comptes Rendus*, 199. *pp.* 193–195, *July* 16, 1934.—Microscopic examination of the electrolysis of gelatin gels discloses two regions around the anode. One, restricted to a narrow band which has pH of about 2, and the second a diffuse swelling accompanied by reduction of thickness of the gel. At the level of this depression, the pH is 4·7, the isoelectric point of gelatin. In acid gels the depression is quite the same except that it occurs from the kathode. A. S. C. L.

3471. Stability and Charge of an Aerosol. N. Fuchs. *Zeits. f. Physik*, 89. 11–12. *pp.* 736–743, *July* 13, 1934.—The application of Smoluchowski's coagulation theory to charged aerosols shows that a unipolar charge powerfully inhibits coagulation, while a bipolar charge acts much more feebly in the same sense. But if we take the rate of decay of the concentration of particles as our criterion of stability of an aerosol, the latter is greatly reduced by a unipolar charge in consequence of the electrical scattering of the particles. A. D.

3472. Coagulation of Colloids and of Smokes. W. R. Harper. *Faraday Soc., Trans.* 30. *pp.* 636–643, *Aug.*, 1934.—The mathematical assumptions made in the derivation of Smoluchowski's formula for the coagulation coefficient of rapid coagulation of colloidal particles and of smokes are shown to be contrary to the conditions actually obtaining. An alternative formula is proposed which differs from that of Smoluchowski by a factor of four. How this formula may be reconciled with the experiments hitherto regarded as confirming Smoluchowski's formula is discussed. This leads to a consideration of the effects of heterogeneity, particle shape and electrical attraction on the coagulation coefficient. AUTHOR.

3473. Liesegang Phenomena. Part I. J. A. Christiansen and I. Wulff. *Zeits. f. phys. Chem.* 26. *Abt.B.* 3. *pp.* 187–194, 1934.—An attempt is made to ascertain whether the wave equations of de Broglie and Schrödinger can be applied for the explanation of the Liesegang phenomena. It is shown that the assumptions made lead to two alternating wave systems from which it follows that the distances between the layers represent only a fourth of a wave-length, and this result, combined with the experimental data of Schemjakin and his co-workers together with the observations of the present authors, leads to a numerical confirmation of the assumptions. The experiments with silver chromate indicate further that the number of lines is finite, a result which follows from the theory. The approximate form of the theory now presented requires that the logarithms of the abscissæ of the precipitate regions should be equidistant, a rule which is approximately correct. The authors' theory is claimed to be confirmed by the experimental data now obtained. H. H. Ho.

3474. Periodic Precipitation Phenomena. B. Težak. *Kolloid Zeits.* 68. *pp.* 60–69, *July*, 1934.—This paper deals with the influence of changes in the concentration of reaction-components upon precipitate-formation. Precipitations of Ag_2CrO_4, $Ag_2Cr_2O_7$, AgCl, AgI and $PbCrO_4$

have been studied in media containing gelatin and also in media free from gelatin, both by nephelometric and absorption measurements. In general, two turbidity maxima have been observed for a constant concentration of one reaction-component in conjunction with a stepwise alteration of the other. The turbidity maxima in the vicinity of the equivalent concentration ratios of the reaction components were decisive for the periodic precipitate-formation. A scheme for the formation of rhythmic structure has been derived, in which the rôle of the charge phenomena upon the surface of the colloidally dispersed precipitate-particles is particularly emphasised. H. H. Ho.

3475. Mechanism of Emulsification. L. Kremnev. *Kolloid Zeits.* 68. *pp.* 16–22, *July*, 1934.—It is shown that the dispersion of one liquid with another must be treated separately from the conditions of stabilisation. The systems carbon tetrachloride-aqueous sodium oleate, benzene-aqueous sodium oleate, water-benzene solution of calcium oleate and water-calcium oleate in carbon tetrachloride are considered. The formation of foam during the emulsification of mercury is described, and, it is shown that stable elementary bubbles of mercury vapour may be obtained which are isolated from the metallic surface. The formation of small spheres of mercury during the destruction of the mercury foam is experimentally demonstrated. A scheme is given which exhibits the mechanism of mercury emulsification and the formation of a polydisperse system during the unconditionally necessary absence of gases. The mechanism for the dispersion of liquids by means of gases is explained, and it is assumed that the disperse phase first forms foam by whose disintegration a polydisperse emulsion arises out of the foam cell walls. The flotation of a heavy liquid at the boundary surface of a specifically lighter liquid and air is described. H. H. Ho.

3476. Phase Volume Theory and the Homogenisation of Concentrated Emulsions. Part II. J. B. Parke. *Chem. Soc., J. pp.* 1112–1115, *July*, 1934.—Examination of benzene/water systems containing magnesium oleate and sodium oleate as oil-in-water and water-in-oil emulsifiers respectively shows that complex emulsions are obtained. [For Part I see Abstract 30 (1934).] A. S. C. L.

See also Abstracts 3463, 3615, 3616, 3780, 3880.

CRYSTAL STRUCTURE AND PROPERTIES.

3477. Calculation of the Lattice Constants of Potassium Chloride. T. Neugebauer and P. Gombás. *Zeits. f. Physik*, 89. 7–8. *pp.* 480–496, *June* 16, 1934.—The authors develop a method for the calculation of the polarisation in an ionic lattice : it follows that improved values are found for the lattice energy and the lattice constant. The remaining energy content is worked out by Thomas-Fermi methods. Values for KCl are produced, involving no arbitrary constants. The polarisation energy is roughly of the same magnitude as the van der Waals, and is inversely proportional to the sixth power of the distance. A discussion follows, dealing with the small discrepancy still outstanding between observed and calculated values. F. I. G. R.

3478. Physics of Crystals. Part I. F. Zwicky. *Rev. Modern Physics*, 6. *pp.* 193–208, *July*, 1934.—A comprehensive review, divided into two sections. In the first, the theory of ideal lattices is discussed, and contrasted with imperfections in real crystals. In the second part, after noticing some experimental facts and giving a number of definitions, the author handles the influence of imperfections, pressure, temperature, cross-section, and concludes with comparisons with the theories outlined at the beginning. F. I. G. R.

3479. Temperature-Structure-Composition Behaviour of Certain Crystals. M. J. Buerger. *Nat. Acad. Sci., Proc.* 20. *pp.* 444–453, *July,* 1934.—Either of two structural types may arise: (*a*) in which element A or B occupies a determined position in a solid solution structure regardless of its neighbours, and (*b*) the structure shows some regular alternation of A and B. The following are then discussed: (1) the potential favourable to the ordered modification; (2) the favoured state for thermal agitation; (3) group rotation and increase in specific heat; (4) possibility of solid solution; (5) segregation. F. I. G. R.

3480. Matrix-Algebraic Development of Crystallographic Groups. F. Seitz. *Zeits. f. Krist.* 88. *pp.* 433–459, *Aug.,* 1934. *In English.*—The first of a series of four papers, in which the Schoenflies method is followed, in that high symmetry groups are derived from subgroups by augmentation. Algebraic treatment places the entire subject upon a basis which is purely analytical group-theory. In the present contribution, the thirty-two macroscopic groups are presented in matrix form. F. I. G. R.

3481. Crystal Drawings from Central Distances. H. Tertsch. *Zeits. f. Krist.* 88. *pp.* 460–465. *Aug.,* 1934.—A number of constructional theorems, based upon the contact polyhedron of the sphere of projection. F. I. G. R.

3482. X-Ray Investigation of the Fine Structure of Copper. F. Lihl. *Zeits. f. Physik,* 89. 9–10. *pp.* 537–545, *June* 26, 1934.—It is shown by X-ray investigations that there is general agreement between the crystallographical processes which take place in iron and copper under various kinds of stress such as tensional, bending or vibrational stress. J. E. K.

3483. X-Ray Investigation of As-Sn System. W. H. Willott and E. J. Evans. *Phil. Mag.* 18. *pp.* 114–128, *July,* 1934.—Powder photographs are taken of fifteen alloys of the As-Sn system. It is found that the phase from 0 % to 29·5 % As is a solid solution and there is no evidence of the compound Sn_3As_2. The compound SnAs has a rock-salt structure and persists as a homogeneous phase from 34·5 % to 49·0 % As. There are two mixture phases extending from 29·5 % to 34·5 % As, and from 49·0 % to 68·0 % As. From 68·0 % to 100 % As the structure is face-centred rhombohedral, the existence of a solid solution of Sn in As being thereby confirmed. Lattice dimensions are given for all the alloys examined. J. T.

3484. Lattice Constant and Expansion Coefficient of Solid Carbon Dioxide. W. H. Keesom and J. W. L. Köhler. *K. Onnes Lab., Leiden, Comm. No.* 232*c. Physica,* 1. *pp.* 655–658, *June,* 1934. *In English.*—The lattice constant of solid CO_2 has been measured at different temperatures between 20 and 114° K. The results, in Ångströms, can be represented by the formula $a_0 = 5{\cdot}540 + 4{\cdot}68{\cdot}10^{-6}\,T^2$. Hence the expansion coefficient in that temperature region is proportional to T. [See Abstract 1409 (1934).] AUTHORS.

3485. Lattice Structure of the Oxides, Sulphides, Selenides and Tellurides of Lithium, Sodium and Potassium. E. Zintl, A. Harder and B. Dauth. *Zeits. f. Elektrochem.* 40. *pp.* 588–593, *Aug.,* 1934.—Details are given of the mode of preparation of the substances mentioned in the title and the results of investigations of their crystal structure by the powder method are tabulated. All the compounds are found to possess the fluorite structure. L. A. W.

3486. Structure of Potassium Lead Chloride. M. Mehmel and W. Nespital. *Zeits. f. Krist.* 88. *pp.* 345–355, *Aug.*, 1934.—The chemical formula of potassium lead chloride is found to be $(\mathrm{K\,Pb\,Cl_3})_3 . \mathrm{H_2O}$. Goniometer measurements indicate that it is monoclinic and this is supported by X-ray measurements. The dimensions of the unit cell are $a = 14 \cdot 3_5$ Å., $b = 9 \cdot 05$ Å., $c = 14 \cdot 5_0$ Å., α and γ are approximately 90° and $\beta = 113°$. The axial ratios are 1·590 : 1 : 1·601. There are four molecules per unit cell. An exact structure is not determined, but approximate atomic positions are obtained. The space group is C_i^1. J. T.

3487. Structure of Tetrabromo- and Tetraiodo-pentaerythrite Determined by Electron Diffraction. H. de Laszlo. *Comptes Rendus*, 198. *pp.* 2235–2237, *June* 25, 1934.—This method, applied to these substances in the gaseous state, shows that in both cases the structure of the molecule consists of a central C atom with 4C arranged tetrahedrally around it and 1·54 Å therefrom, with the Br or I atoms 1·94 in $\mathrm{C(CH_2Br)_4}$ and 2·10 in $\mathrm{C(CH_2I)_4}$ on the further side of each of these four, but depressed or raised relatively to the adjacent C atom so that the four halogens are in one plane with the central C atom, forming a square the diagonal of which is 6·0 Å in the bromo, and 6·3 in the iodo compound. [See Abstracts 2588 (1929) and 3118 (1932).] C. A. S.

3488. Influence of Temperature on Crystal Mesh of Some Normal Dibasic Fatty Acids. F. D. la Tour and (Miss) A. Riedberger. *Comptes Rendus*, 199. *pp.* 215–217, *July* 16, 1934.—The coefficient of expansion, k_a (per 1 Å per 1°) of the a axis $(\times 10^5)$ and the spacings $d_{(001)} = c \sin \beta$ of the normal dibasic fatty acids are: C_{10} acid, 27, 11·02; C_{12} 30, 13·04; C_{14} 57, 15·44; C_{16} 44, 17·41; C_{18} 38, 19·45; C_{20} 47, 21·70 respectively; k_b is very small. A possible explanation of the varying differences between the figures for successive pairs of acids, based on the probable differences in the distances between the carboxyl groups of neighbouring molecules, is suggested. C. A. S.

3489. Swarm Theory of Liquid Crystals. L. S. Ornstein. *K. Akad. Amsterdam, Proc.* 37. 6. *pp.* 318–322, 1934.—The swarm theory can be stated thus—If at a point P, the axis of a molecule lies in the direction A, the position of another molecule at distance Z is no longer arbitrary. There is a probability given by $g(z\phi)d\Omega$ that the axis of the second molecule forms an angle ϕ with the A direction. F. I. G. R.

3490. Orientation of Molecules in Thin Films of Anisotropic Liquids. V. Fréedericksz and V. Zvetkov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. *pp.* 548–553, *June* 21, 1934. *German Summary.*—A thin anisotropic liquid film between object and cover glass may have a homogeneous or inhomogeneous structure. A film which in the absence of an external field is homogeneous may become inhomogeneous in an external magnetic or electric field and *vice-versa.* The experiments are made with *p*-azoxyanisol because of its large double refraction, and the orientation of the molecules within certain limits can be determined by observation of the limit of total reflection for the extraordinary ray, if the ordinary and extraordinary refractive indices are known. The paper describes experiments made and a method of calculating two elastic constants. The theroetical and experimental values of the maximum angle of rotation of a particle in the middle of a thin film agree to within about 4 %. R. L.

3491. Theory of Anisotropic Liquids. Part XX. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 24A. *No.* 14. *pp.* 1–18, 1934. *In German.*—A discussion (almost wholly mathematical) of the symmetry of the free energy, and orientation in very simple cases. A special instance, of great interest for group-theory, is handled, *viz.* $\int J_2 d\omega =$ extremum. The paper concludes with a treatment of spatial problems. [For Part XIX see Abstract 42 (1934).] F. I. G. R.

3492. Theory of Anisotropic Liquids. Part XXI. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 24.A. *No.* 19. *pp.* 1–11, 1934. *In French.*—A mathematical treatment of the forms of the terms giving the potential energy. In established notation, the term is of the form $c_{33}D_{33}$ (axis of symmetry $L^{(3)}$). Again the sign of $\frac{1}{2}c_{jk}(D_{jk}+D_{kj})$ depends not only upon the D's, but also upon c_{jk}. [See preceding Abstract.]
F. I. G. R.

3493. Various Forms of Carbon. M. Miwa. *Tohoku Univ., Sci. Reports,* 23. *pp.* 242–258, *May,* 1934. *In English. Report No.* 321 *from the Research Inst. for Iron, Steel and other metals.*—A kathode-ray diffraction apparatus, similar to that used by Kikuchi, is described for the examination of powdered specimens, particularly various kinds of graphite and amorphous C. It is shown that the crystal lattice of graphite expands in the direction of the principal axis as the grain size decreases, whilst it remains nearly unchanged in other directions. Measurements of the magnetic susceptibility of the specimens show that this is proportional to grain size. H. J. H. S.

3494. Crystallisation of Carbon under High Pressures. J. Basset. *Comptes Rendus,* 199. *pp.* 144–146, *July* 9, 1934.—The crystallisation of carbon to form the diamond was studied under a series of pressures ranging from 3000 to 25,000 kg./cm². Attempts were made to dissolve carbon in different metals employing the thermite reaction. The carburised metals obtained were examined, but within the range of pressures employed, carbon in the graphitic state alone was obtained. In some experiments very minute microscopic crystals were obtained, but the quantity was insufficient for their nature to be determined. F. J. B.

3495. Molecular Configuration and its Relation to Modification of Crystal-Growth. H. E. Buckley. *Zeits. f. Krist.* 88. *pp.* 381–411, *Aug.,* 1934. *In English.*—The list of dyes affecting the (011) planes of $KClO_3$ crystals [see Abstract 2151 (1933)] is extended and a similar list of those affecting the (010) faces of K_2SO_4 crystals. In the great majority of cases, the deciding factor in this effect is the presence of a SO_3Na group, which seems to make any large molecule containing it effective. The influence of the position of various substituents has been investigated.
T. H. P.

3496. Spherulites with Helicoidal Winding from the Allantoins and their Artificial Coloration. P. Gaubert. *Comptes Rendus,* 199. *pp.* 213–215, *July* 16, 1934.—The spherulites obtained on allowing a thin layer of a supersaturated solution of the three allantoins (*d*—, *l*— and *r*—) to crystallise slowly on a sheet of glass without, and with, addition of methylene blue are described; in the latter case there is strong polychroism. The spherulites formed by the *l*— and *r*—allantoins exhibit helicoidal winding, but not those from the *d*—isomer. Methylene blue and allantoin do not form a solid solution, but merely crystallise together. C. A. S.

3497. Fibrous Structure in Ionic Lattices. Part II. G. R. Levi and M. Tabet. *Accad. Lincei, Atti,* 19. *pp.* 723–725, *May* 20, 1934.—According to the temperature at which AgCl and AgBr are drawn into wires under high pressures [see Abstract 1408 (1934)], fibrous structures orientated according to either (100) or (111) may be obtained. Reasons for such variation in orientation are suggested. For AgCl and AgBr orientated according to (100) the breaking stresses are respectively 3·78 and 3·91 kg./mm^2., the corresponding values for the (111) orientation being 5·60 and 6·36. T. H. P.

3498. State of Cerium Atom Inside the Metallic Lattice. R. Jaanus and V. Drožžina. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. *pp.* 413–414, *June* 1, 1934. *In English.*—The susceptibility of a very pure polycrystalline sample of metallic cerium was measured at temperatures varying from −170° C. to +100° C. It is concluded that the metallic lattice of Ce may be probably regarded as consisting either of Ce^+ or of Ce^{+++} ions possessing equal values of the magnetic momentum. The chemical properties of Ce^+ lead to the assumption that Ce^{+++} may be the most probable state. Thus the results seem to show that in Ce there exist either one or three "free" electrons per atom. At temperatures below 6° Abs. Ce may become ferromagnetic. J. J. S.

3499. Advantages of the Face-Adjustment for Two-Circle Goniometry. M. H. Hey. *Min. Mag.* 23. *pp.* 560–565, *June,* 1934.—A discussion of a number of experimental questions, partly by comparison with zone-adjustment methods. It is held that the projection and computation can be as straightforward with face-adjustments as with zone-adjustments. F. I. G. R.

3500. Weissenberg Reciprocal Lattice Projection. M. J. Buerger. *Zeits. f. Krist.* 88. *pp.* 356–380, *Aug.,* 1934. *In English.*—The form of the reciprocal lattice line curves on Weissenberg photographs is derived for the case in which the X-ray beam is inclined to the rotation axis so that $\beta = \mu$, and for the case in which the X-ray beam is normal to the rotation axis. In the first case the form of the curves is the same for all layer lines and data are given for the construction of a template with the aid of which the reciprocal lattice lines may be sketched in on the photograph. The indexing of a film and the construction of the reciprocal lattice are also discussed. In the second case the form of the reciprocal lattice curves varies with the ζ co-ordinate of the layer line and no single curve-form template can be used. J. T.

3501. Crystallisation Forces. A. Schubnikow. *Zeits. f. Krist.* 88. *pp.* 466–469, *Aug.,* 1934.—A dynamometer is constructed, consisting of a glass thread at the end of which is a small sphere. At any instant, from the displacement of the thread, a measure is obtained of the forces exerted by the growing crystal. A test with potassium alum yielded 0·89 gm./cm^2. F. I. G. R.

3502. Disperse Structure of Mixed Crystals. D. Balarew. *Kolloid Zeits.* 68. *pp.* 33–36, *July,* 1934.—The temperatures at which measurable decomposition occur are found. The change of temperature with composition is the opposite of that expected on the theory of dilute solutions. A mosaic structure is suggested to account for this. F. I. G. R.

See also Abstracts **3464, 3509, 3510, 3709, 3790, 3791, 3792, 3797, 3814, 3902, 3916, 3920, 3938, 3956.**

DIFFUSION AND OSMOSIS.

3503. Thermal Diffusion. G. and O. Blüh. *Zeits. f. Physik*, **90**. 1–2. *pp*. 12–37, *July* 24, 1934.—Thermal diffusion is observed in mixtures of H_2 and CO_2 and of H_2 and N_2, by an optical method. The change of the refractive index of the gas during the experiment is measured in a Jamin interferometer. This method is suitable over a wide temperature range, and for mixtures in which a high percentage of one gas occurs. The experiments show that at low temperatures a deviation from the Chapman law $\delta\lambda = k \log T_2/T_1$ occurs in both cases ($\delta\lambda$ is the percentage separation of the gases, T_1, T_2, the temperatures of the two sides of the chamber). As previously found, k, derived from measurements, is much lower than the theoretical value based on the perfectly elastic spherical molecule. The results are compared with those of Ibbs [see Abstract 1690 (1925)] and others, and their bearing on the estimation of intermolecular force discussed. For the H_2, CO_2 mixture this force is found to vary inversely as 6·5th power of the distance. J. P. A.

3504. Osmotic Pressure of Substances of High Molecular Weight. Alma Dobry. *Comptes Rendus*, **199**. *pp*. 289–290, *July* 23, 1934.—Experiments (not described) upon the osmotic pressure of extremely weak solutions of nitrocellulose show that at concentrations about 0·05 %, the osmotic pressure is proportional to the concentration; and does not vary with the solvent. Previous experiments, at higher concentrations, have given an osmotic pressure nearly proportional to the square of the concentration, and varying with the solvent. The " molecular weight " of the nitrocellulose complex, calculated from the new experiments is 110,000. Probably all colloids would show normal osmotic pressure if investigated in sufficiently weak solutions. J. P. A.

3505. Membrane Equilibria and the Phase Rule. O. Gatty. *Phil. Mag*. **18**. *pp*. 273–288, *Aug*., 1934.—The phase rule has been extended to systems in which membranes operate. The equations for Donnan equilibrium in certain simple cases have been deduced. They are similar to those given by Donnan and Guggenheim where these authors have calculated a corresponding equation, but are given in terms of quantities which may turn out to be obtained with less experimental labour. A simple three-phase Donnan equilibrium is discussed and the possibility of polyphase membrane equilibria playing a rôle in vital processes is pointed out. AUTHOR.

See also Abstracts 3473, 3562, 3795, 3824.

ELASTICITY AND PLASTICITY.

3506. Flexure of a Beam Upon Elastic Supports. M. Kourensky. *Tohoku Math. J*. **39**. *pp*. 192–199, *June*, 1934. *In German*.—Shows how the differential equation met with in this problem may be solved completely with the aid of Lagrange's method of variation of constants. J. P. A.

3507. Differential Equation in the Theory of Plasticity. C. W. Oseen. *Arkiv f. Mat. Astron. och. Fysik, Stockholm*, **24A**. *No*. 13. *pp*. 1–9, 1934. *In German*.—If the Airy stress function, and velocity potentials are introduced into the equations for plastic flow in the two dimensional case, a partial differential equation of the fourth order results. This equation is derived and discussed. J. P. A.

3508. Mechanism of Plastic Deformation. A. W. Stepanow. *Phys. Zeits. d. Sowjetunion*, 5. 5. *pp.* 706–713, 1934. *In German.*—Referring to previous work [see Abstract 453 (1934)] further evidence is brought forward to show that phase changes occur at the slip planes of a permanently deformed crystalline solid. General considerations upon the energy changes follow. J. P. A.

3509. Plasticity of Crystals. E. Orowan. *Zeits. f. Physik*, 89. 9–10. *pp.* 605–659, *June* 26, 1934.—In Part I, Becker's formula for the rate of slip u in a crystal deformed beyond its elastic limit [see Abstract 2211 (1925)] is shown to yield the following equation for the variation of the yield stress σ with temperature, *viz.*, $\sigma = \sigma_0 - B\sqrt{T}$, where σ_0 and B are constants. The yielding is considered to occur when the velocity of flow attains an arbitrary value; and the form of the equation for σ is shown to be insensitive to changes in this chosen value. Experiments upon Zn and Cd crystals bear out the relation over a wide temperature range. In Part II the significance of the relation between shear stress and the rate of slip is considered in greater detail; and observed data are analysed with the aid of the Becker formula for u. The distinction between the static view of slip and the Becker dynamical view is emphasised. In Part III are described experiments to elucidate the mechanism of slip, and the conclusion reached is that in a crystal both the "static" process originated by microscopic faults, and the "dynamic" process due to thermal fluctuations are operative. The latter process makes the onset of slip more gradual. The connection between microscopic dislocation and observed slip is discussed. J. P. A.

3510. Lattice Distortion which Originates Plastic Flow. M. Polanyi. *Zeits. f. Physik*, 89. 9–10. *pp.* 660–662, *June* 26, 1934.—If in a crystal a plane can be found, such that n atoms on one side are opposed to $n+1$ atoms on the other, the dislocation tends to be propagated in one direction or the other. In this way a slip plane may originate. Such a dislocation is more likely to occur at a boundary of a crystal and be propagated inwards, and in this connection the effect of solution on the plasticity of rock-salt is cited. J. P. A.

3511. Longitudinal Vibrations of a Thin Plate. R. Einaudi. *N. Cimento*, 11. *pp.* 296–298, *May*, 1934. *Accad. Sci. Torino, Atti*, 69. I. *Disp.* 3., *pp.* 432–435, 1934.—The longitudinal vibrations of a thin plane sheet are studied by reducing the differential equations expressing their propagation to the equations of cylindrical waves. J. J. S.

3512. Resonance Curves for Vibrating Rods. L. Cremer. *Preuss. Akad. Wiss. Berlin, Ber. No.* 1. *pp.* 2–24, 1934.—Electrical analogy is employed in calculating the particle velocities in the longitudinal and flexural oscillations of a rod by the four-pole method. Forced oscillations and resonance are chiefly considered. J. P. A.

3513. Vibration of Beams and Whirling of Shafts. H. H. Jeffcott. *Roy. Dublin Soc., Proc.* 21. 10. *pp.* 87–112, *Aug.*, 1934. —A detailed account with simple examples, of a method of successive approximation which simplifies the more involved calculations in the problems of vibrating and whirling shafts, and gives results sufficiently accurate for constructional purposes. Graphical and tabular methods are largely employed. J. P. A.

3514. Lateral Vibration of Ring-Shaped Frames. F. H. Brown. *Frank. Inst., J.* 218. *pp.* 41–48, *July*, 1934.—A frame in the form of a circular arc is rigidly fixed at both ends. The frequency of oscillation perpendicular to the plane of the circle is calculated by an approximate method, and the results are verified experimentally. J. P. A.

3515. Mechanical Wave-Filters. H. W. Koch. *Zeits. f. angew. Math. u. Mechanik*, 14. *pp.* 173–177, *June*, 1934.—A list of analogous quantities in the theories of electricity and elasticity is drawn up, and on the basis of the formal parallel between the theories, the properties of a number of mechanical wave-filters are considered. These, which consist of chains of springs and masses, are analogues of common types of electrical wave-filters. J. P. A.

3516. Uniformity of Hardness of a Single Test Specimen. C. Benedicks and C. F. Mets. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 24*A*. *No.* 15. *pp.* 1–14, 1934. *In German.*—In normal hardness testing, a number of test specimens must generally be used to derive a reliable estimate of the hardness of a particular sample of material, owing to the variation in individual specimens. In the method here developed a single specimen suffices and the variation in hardness over its polished surface may be readily observed. The specimen is polished and its surface is scratched in a number of parallel lines with a diamond point of specified design and load. The method is easy to apply and is sensitive to small local variations in hardness. H. J. H. S.

See also Abstracts 3490, 3497, 3521, 3613, 3616, 3683.

GRAVITATION.

3517. Deduction of Mass Anomalies from Gravity Gradients. K. Jung. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 338–346, 1934.—The influence of the inaccuracy of observations on the determination of simply distributed mass anomalies from gradient measurements is discussed. W. A. R.

3518. Improved Jolly Balance. G. Schmerwitz. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 274–295, 1934.—Reference is made to the account of S. Reisch [see Abstract 1926 (1934)], in which are described the various influences which have to be taken into account when aiming at high sensitivity in a balance of the Jolly type. The present article describes elements of the theory of such a balance to which a horizontal pendulum is added for the purpose of increasing the sensitivity. For the two lateral knife-edges, strip suspensions were substituted. In the first part of the paper, the dynamical equations of the complete oscillating system of balance and pendulum are obtained. Secondly, the equations of equilibrium are derived for the balance when the knife-edges are replaced by strip suspensions. No advantage is found in substituting a strip for the central knife-edge. The optimum dimensions of the strips are discussed. E. L. J.

See also Abstracts 3559, 3560, 3632.

HYDRODYNAMICS AND AERODYNAMICS.

3519. Reynolds Number as the Ratio between Transverse and Longitudinal Pressure Gradients. M. Lang. *Phys. Zeits.* 35. *pp.* 475–476, *June* 15, 1934.—It is shown mathematically that for flow through a capillary tube the Reynolds number is equal to the ratio of the transverse to the longitudinal pressure gradient. The commencement of turbulence occurs at the walls and is conditioned by the movement of particles of the fluid from the walls to the centre under the influence of the transverse gradient. H. F. G.

3520. Motion of an Elliptic Cylinder Through a Viscous Fluid. G. J. Richards. *Roy. Soc., Phil. Trans.* **233. 726A.** *pp.* **279–301,** *July* 18, **1934.**—The flow of a viscous fluid past an elliptic cylinder has been compared with mathematical theory and agreement between them has been found to be close (in that region of the field) in the neighbourhood of the front of the cylinder. In the outer field, and towards the back of the cylinder, deviations occurred between theory and experiment owing to the fact that the effects of the boundary walls and of the wake had been neglected. The results obtained, however, justify an extension of the method employed to conditions where the presence of the walls is considered, and where the influence of the eddying wake is taken into account. AUTHOR.

3521. Propagation of a Group of Periodic Waves on the Surface of a Liquid. J. Baurand. *Comptes Rendus,* **199.** *pp.* **122–123,** *July* **9, 1934.**—There are several velocities of propagation in a limited group of sinusoidal waves, and those of the front and the rear of the group are the most difficult to verify as already indicated by Brillouin [see Abstract 5237 (1932)]. A method of producing a train of waves by a cylinder caused to plunge periodically into water by electromagnetic means is used, and the velocity of the crests and troughs is found to agree with Kelvin's formula for a frequency of 50. The difference between the velocities of the back and front of the group is slight, but shorter waves should give more definite results. H. M. B.

3522. Second Approximation in the Theory of Viscous Liquids. C. W. Oseen. *Arkiv f. Mat., Astron. och Fysik, Stockholm,* **24A.** *No.* **20.** *pp.* **1–23, 1934.** *In French.*—Purely mathematical. H. F. G.

3523. Flow Due to a Rotating Disc. W. G. Cochran. *Cambridge Phil. Soc., Proc.* **30.** *pp.* **365–375,** *July* **30, 1934.**—The author directs attention to algebraic and numerical inaccuracies in Kármán's approximate treatment of the steady motion of an incompressible viscous fluid due to an infinite rotating plane lamina [*Handbuch der Physik,* 7 (1927) 158, 159], and shows how the fundamental equations of Kármán's theory can be solved by a process of numerical integration. J. S. G. T.

3524. Ground Water Flow. G. Hamel. *Zeits. f. angew. Math. u. Mechanik,* **14.** *pp.* **129–157,** *June,* **1934.**—A detailed mathematical treatment is given of the flow of water through soils. H. F. G.

3525. Water-Flow Indicator. F. Adcock. *Journ. Sci. Instruments,* **11.** *p.* **258,** *Aug.,* **1934.**—A drawing and a short description is given of a water-flow indicator in which an indicator ring is raised by the water stream. The glass part of the instrument is readily replaceable. AUTHOR.

See also Abstract 3630.

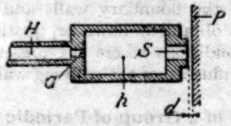
KINETIC THEORY OF MATTER.

3526. Brownian Motion as Natural Limit to Measuring Processes. R. B. Barnes and S. Silverman. *Rev. Modern Physics,* **6.** *pp.* **162–192,** *July,* **1934.**—An exhaustive account showing how the Brownian movement, by introducing random, uncontrolled motions, sets a limit to fine measurements of nearly every kind. Thirteen cases of mechanical and electrical systems are taken as examples, and the magnitude of the Brownian perturbations discussed. An historical summary and a Bibliography are included. J. P. A.

See also Abstracts 3503, 3707, 3824, 3937.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

3527. Pneumatic Micrometer. *Journ. Sci. Instruments,* 11. *pp.* 229–231, *July,* 1934.—The principle underlying this instrument is shown in the figure. The tube H is connected to an air-line and communicates with a reservoir through the adjustable aperture G. A second aperture S affords means of egress for the air. If the aperture S abuts against a surface P, the air pressure *h* increases to an extent depending on the gap *d*. If now such a system be made in the form of, say, a plug gauge, the excess pressure is a measure of the excess size of the measured object over that of the gauge. The details of the complete apparatus are given, including a device for maintaining constant pressure in G, and it is shown that this type of micrometer may be used for many purposes, including plug gauges and internal limit gauges, for checking round bars, etc. G. E. B.



See also Abstract 3665.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3528. Application of the Calculus to Scientific and Technical Research. M. Picone. *Elettrotecnica,* 21. *pp.* 397–402, *June* 25, 1934.—An institute has been formed to deal with problems in science, engineering and industry by means of the calculus. Methods are considered of applying, solving and reducing to numerical values the differential equations which are particularly useful in electrotechnics. The problem here considered is that of the propagation of electromagnetic waves and heat, according to the dependence of the various quantities upon time and position. This leads to the consideration of the construction of transformers, starting electric motors, thermionic currents, etc. Numerical results and graphs are given. H. M. B.

3529. Potential Functions with Periodicity in One Coordinate. R. C. J. Howland. *Cambridge Phil. Soc., Proc.* 30. *pp.* 315–326, *July* 30, 1934.—The conception underlying the analysis is that of a field of potential invariant under a group of geometrical transformations. The boundary is to consist of a number of parts which transform into each other as also do the boundary values. Functions are built up which are invariant under the same group of transformations and they are combined to give the prescribed boundary values over one section of the boundary. The boundary conditions on the other sections are then automatically satisfied. When the groups are simply translations or rotations, functions are obtained which are periodic in either a cartesian or an angular coordinate. R. S. R.

3530. Parabolic Cylindrical Functions. S. C. Dhar and N. A. Shastri. *Phil. Mag.* 18. *pp.* 401–405, *Aug.,* 1934.—The object of the paper is to study some of the properties of parabolic cylindrical functions by contour integration. The differential equation often used in problems of mathematical physics $(ax^2 + c)\,d^2y/dx^2 + ax\,dy/dx + (ck^2x^2 + b)y = 0$ is taken and a solution obtained as a homogeneous integral equation.

From this the integral equation of the parabolic cylindrical function is obtained in the form $D_n(z) = \lambda \int_{-\infty}^{\infty} e^{\frac{i\theta z}{2}} D_n(\theta) d\theta$. The value of λ is then found by the method of contour integration. R. S. R.

3531. Method. P. Jordan. *Naturwiss.* 22. *pp.* 485–490, *July* 20, 1934.—A full disquisition on the various modes of perception of scientific fact, objective and subjective ; with special reference to the " positivistic " method. A. D.

3532. Statistical Theory of Errors. W. E. Deming and R. T. Birge. *Rev. Modern Physics*, 6. *pp.* 119–161, *July*, 1934.—In the paper the authors sought to collect the pertinent facts of the statistics of a sample in such a form that they would be useful for the interpretation of physical data since a working knowledge of the theory of errors is indispensable to their interpretation. The general principles underlying the branch of statistics concerned with the theory of errors is outlined and it is shown that the true value of the quantity being measured is approached by correcting for systematic errors one after another. The effect of accidental errors can be reduced as far as desired by taking sufficient observations. The measurement of each systematic correction presents a problem in statistics, since a correction cannot be applied intelligently unless its precision is stated. In this mathematical paper consideration has been given to (1) the specification of the parent population, (2) the distribution of certain properties of samples drawn from a normal parent population, and (3) the estimation of probable error. R. S. R.

3533. Probability and Scientific Method. R. A. Fisher and H. Jeffreys. *Roy. Soc., Proc.* 146. *pp.* 1–16, *Aug.* 1, 1934.—Fisher (*pp.* 1–8) replies to Jeffreys' criticism of his work on this subject [see Abstracts 83 and 3344 (1933)]. He contends that Jeffreys' supposition that, two measures being made, the probability that the third observation will lie between them, has two distinct meanings, one true, the other demonstrably false. (2) Jeffreys (*pp.* 9–16) replies to Fisher. J. S. G. T.

3534. Interconversion Scale for Energy, Temperature and Atomic Weight. C. H. D. Clark. *Phil. Mag.* 18. *pp.* 80–89, *July*, 1934.—Extends and improves the accuracy of the interconversion scale already described [see Abstract 1859 (1934)]. W. S. S.

See also Abstract 3703.

MECHANICS, CLASSICAL.

3535. Centrobaric Bodies. A. Pleijel. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 24*B*. *No.* 12. *pp.* 1–6, 1934. *In French.*—A centrobaric body is one whose gravitational attraction at all points outside the body is the same as if the whole mass were concentrated at one point, which must be the centre of gravity of the body. The author proves that of all homogeneous bodies having a continuous surface the only centrobaric body is the sphere. A. J. McC.

3536. Rolling with Slipping. R. Lévi. *Comptes Rendus*, 199. *pp.* 119–120, *July* 9, 1934.—If two surfaces, S and S′, roll upon one another there will be a certain deformation of the area of contact, with a certain slip. To the area of contact apply obliquely a force with a tangential component F ; there will be a further deformation, and further slipping will occur. Experimentally, the motion is best described, not by making the slip proportional to F, but by a hyperbolic law. The force F causes a slip with friction and dissipation of energy. A total displacement U of S is made up of elastic displacements u and u', together with a slip-displacement u_g. For these quantities take their projections on F. We then have $u + u' = F/k$ and $\Phi u_g = FU$; whence $\frac{1}{F} = \frac{1}{kU} + \frac{1}{\Phi}$, the hyperbolic law referred to. Applications to problems in transport on railway rails. A. D.

3537. Definition and Properties of the Centre of Gravity in Mechanical Vibration. J. L. Destouches. *J. de Physique et le Radium*, 5. *pp*. 320–328, *July*, 1934.—A definition is given of the centre of gravity of a system of corpuscles in mechanical vibration, and its mean position and the mean square error are studied. Having established that it acts as a heavy corpuscle and that its motion satisfies Heisenberg's relations of uncertainty, its motion is described by means of wave equations. With the help of the notion of operators " correspondingly equal " a certain number of theorems in wave mechanics are established for the system analogous to those in classical mechanics amongst which are theorems analogous to those of Koenig. The equation of wave motion of the centre of gravity is established as that of relative motion around the centre of gravity. A system of two corpuscles is cited as an example and it is shown how to introduce the reduced mass. Finally, with the help of this idea of the centre of gravity a definition is given in a precise way of a " perfectly solid body " as that of different systems of classical mechanics, and the problem of their existence is set out clearly. R. S. R.

3538. Force of Inertia in Free-Falling Wick Flames. H. Lorenz. *Phys. Zeits*. 35. *pp*. 529–530, *July* 1, 1934.—This photographic investigation of free-falling flames up to their extinction points, shows clearly that, depending on the suppression of buoyancy, the flame gases stream away radially because of the thermal movement before the flame is extinguished through deficiency of oxygen. For the explanation of the phenomenon it can be said either that a body falling free is deprived of weight or that inertia force appears, the free fall being regarded as the limiting case of an accelerated reference system. H. H. Ho.

3539. Investigation of Gauss Distribution Curve with the Galton Table. W. Seitz and K. Hamacher-Odenhausen. *Phys. Zeits*. 35. *pp*. 530–532, *July* 1, 1934.—Experimental results with the Galton table for different inclinations and for varying sizes of balls, in order to investigate the Gauss distribution curve, have in no case corresponded with the theoretical demands. Failure is ascribed to experimental limitations.

H. H. Ho.

MECHANICS, QUANTUM.

3540. Heisenberg's Principle of Indeterminacy and its Epistemological Significance. M. v. Laue. *Naturwiss*. 22. *pp*. 439–442, *June* 29, 1934.—It is argued that Heisenberg's principle of indeterminacy sets a limit to knowledge in the frame of a corpuscular theory, but not to physical knowledge generally. The present basic conceptions of physics involve unrecognised contradictions ; the frequent appearance of " electron radius " in the literature, points to one such inconsistency, for electron radius is a survival of early ideas on the occupation of space by matter which are difficult to reconcile with modern corpuscular theory. A

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completely causal interpretation of physical processes is not necessarily excluded by the Heisenberg principle. W. S. S.

3541. Inapplicability of Geometry to Small Physical Regions. E. Schrödinger. *Naturwiss.* 22. *pp.* 518–520, *Aug.* 3, 1934.—The author puts forward the view that the processes assumed to occur in regions of atomic dimensions by modern quantum theory are such that the ordinarily assumed postulates of geometry are no longer applicable to such regions. G. C. McV.

3542. Dirac's Theory of "Holes" and the Velocity of Light. H. C. Brinkman. *Physica,* 1. *pp.* 925–928, *July,* 1934. *In German.*—The consequences, with regard to the propagation of light, of Dirac's assumption that all the states of negative energy for an electron are filled, with the exception of a few "holes," are worked out. These negative electrons produce a dispersion in a vacuum which leads to the conclusion that the velocity of light is either zero or negative infinity. G. C. McV.

3543. Tensor Fields Accompanying the Dirac Electron. Theory of Neutrino and Anti-Neutrino. B. Kwal. *Comptes Rendus,* 199. *pp.* 23–24, *July* 2, 1934.—The author speculates as to the physical significance of certain tensors associated with Dirac's theory of the electrons. G. C. McV.

3544. Spinors. O. Veblen. *Washington Acad. Sci., J.* 24. *pp.* 281–290, *July* 15, 1934.—A non-technical account is given of the theory of spinors and of their use in the extension of Dirac's theory of the electron to general relativity. G. C. McV.

3545. Mathematical Theory of Schrödinger's Equation. T. Carleman. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 24B. *No.* 11. *pp.* 1–7, 1934. *In French.*—The paper contains some general theorems on the solutions of Schrödinger's equation. G. C. McV.

3546. Interchange in the Thomas-Fermi Atom. H. Jensen. *Zeits. f. Physik,* 89. 11–12. *pp.* 713–719, *July* 13, 1934.—Dirac's Thomas-Fermi equation with interchange is deduced from the interchange energy of the Fermi gas and a minimum energy for the atom, and is approximately solved, in the light of Ritz's experiment. The interchange demands a correction in the virial law, which is given. A. D.

3547. Quantum-Dynamical Summation Law. V. Fock. *Zeits. f. Physik.* 89. 11–12. *pp.* 744–749, *July* 13, 1934.—Shows that the usual form of the summation law for the "oscillation strengths" of the valence-electrons is only valid when we neglect the exchange effect; taking the latter into account introduces substitution-terms. It is possible thus to explain the apparent divergences from the summation law. A. D.

See also Abstracts **3462, 3473, 3537, 3539, 3915.**

RELATIVITY AND ETHER.

3548. Dependence of Lorentz Contraction on Index of Refraction. L. Courvoisier. *Zeits. f. Physik,* 90. 1–2. *pp.* 48–62, *July* 24, 1934.—The author's level apparatus consists of two sensitive levels, one on a T-base, the other free to swing about a central axis. The two are parallel. Comparisons of the two levels show a difference between their readings which varies in the period of a sidereal day. This, with astronomical evidence, leads the author to postulate a measurable Lorentz contraction of the earth, due to its translation through space; this would be an absolute translation; the speed is about 500 km./sec. The present paper contains a summary of the author's theory, the details of further measurements in 1933, and of measurements in which two levels are mounted on different solids, or in which one is surrounded by an oil or other liquid; these show that the observations are unaffected by the index of refraction of the bodies concerned or by that of the surrounding medium. T. L. M.

3549. Lorentz-Einstein Transformations. T. Takéuchi. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 252–253, *July*, 1934. *In English.*—It is shown that the Lorentz-Einstein transformations of space and time do not contradict the idea of absolute space and time. AUTHOR.

3550. Energy-Momentum Principle and Metric in a Non-Conservative Mechanics. R. C. Tolman. *Nat. Acad. Sci., Proc.* 20. *pp.* 437–444, *July*, 1934.—It is suggested that the generalisation of the energy-momentum principle in mechanics where energy-conservation is not assumed should be $(T^{\mu\nu})_\nu = B^\mu$, where $T^{\mu\nu}$ is the energy tensor, $B^\mu = b_0 dx^\mu/ds$ and b_0 is the rate of energy production per unit volume as measured by an observer at rest. It is also suggested that, on the assnmption that the energy created will have the same effect on the metric as that already present, the equations of general relativity should be $8\pi T^{\mu\nu} = R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + D_{\mu\nu}$, where $R_{\mu\nu}$ is the Riemann-Christoffel tensor and $D_{\mu\nu}$ is governed by the equation $g^{\alpha\beta}(D_{\mu\nu})_{\alpha\beta} = -8\pi(B_\mu)_\nu - 8\pi(B_\nu)_\mu + 8\pi(B^\alpha)_\alpha g_{\mu\nu}$. G. C. McV.

3551. Universal Field Theory. K. Novobatzky. *Zeits. f. Physik*, 89. 11–12. *pp.* 750–756, *July* 13, 1934.—The author translates some results of the expanding universe theory of general relativity and some of the Dirac electron theory into the terms of his field theory. [See Abstract 3158 (1934).] G. C. McV.

3552. Unified Field Theory. T. Awano. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 244–251, *July*, 1934. *In English.*—Mathematical. Opens up a method whereby, starting from first principles, the geometry of both the gravitational and the electromagnetic field is reduced to Eddington's "natural geometry," the single true geometry of the world as considered by the physicist. Further papers are to follow. A. D.

See also Abstracts 3538, 3544, 3896.

SOLUTION.

3553. Influence of Ionic Forces on the Dissociation of Organic Acids of Medium Strength. H. v. Halban and G. Kortüm. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 502–507; *Disc.*, 507, *July*, 1934.—The concentration dissociation constant K_c of α-dinitrophenol is measured, by an optical method, in aqueous solution and in the presence of various inorganic neutral salts. The mean activity coefficient $f_{H+} . f_{A-}$ of the dinitrophenol ion (at concentrations below 0·01 *M*) are calculated from the Debye-Hückel formula. On the assumption that, in dilute solution, $f_{HA} = 1$, the true thermodynamic dissociation constant K_a can be calculated. The values so derived agree well with those obtained by extrapolation of the K_c curve. The results show that in solutions with various univalent electrolytes up to an ion concentration of 0·01 M, K_e increases equally. At higher salt-concentrations, individual variations occur for the various salts; and at 0·5 M solutions, K_e passes through a maximum and then decreases rapidly. The advantages of the optical method are discussed. C. B. A.

3554. Activity of Sodium in Concentrated Liquid Amalgams. E. S. Gilfillan, Jr., and H. E. Bent. *Am. Chem. Soc., J.* 56. *pp.* 1505–1509, *July*, 1934.—The activity of sodium in concentrated liquid sodium amalgam is approximately the same as that of the solid metal. Sodium amalgams cannot be well represented by the equation $\log a_2/N_2 = {}^1/_2\,\beta N_1^2$, which has been used successfully in treating so many solutions. The vapour pressure of mercury from concentrated liquid sodium amalgam is probably much less than 10^{-10} mm. AUTHORS.

3555. Effect of One Salt on the Solubility of Another. Part V. Solutions in Allyl and Benzyl Alcohols. J. R. Partington and R. J. Winterton. *Faraday Soc., Trans.* 30. *pp.* 619–626, *Aug.*, 1934.—The effect of the dielectric constant of the solvent has been examined by measurement of solubilities in allyl and benzyl alcohols and comparison with results for ethyl alcohol. The salts used to saturate the solvent were KI and NaCNS; and NaI was used to introduce a common ion. [For Part IV see Abstract 2676 (1930).] A. S. C. L.

3556. Composition of Solutions Saturated with Any Number of Strong Electrolytes. G. Akerlöf. *Am. Chem. Soc., J.* 56. *pp.* 1439–1443, *July*, 1934.—The method given in a previous paper [see Abstract 1881 (1934)] for the calculation of the composition of the liquid phase in a ternary system formed by two strong electrolytes and water as a solvent has been extended to poly-component systems with an arbitrary number of uni-univalent, strong electrolytes present in the solid or the liquid phase. A study of the constants needed for the equations employed has shown that they follow rules that are unexpectedly simple. Using a new universal constant, the known k_1 and k_2 values for some reference electrolyte, the composition of the liquid phase may be calculated for any poly-component system containing as pure solid phases any electrolyte with known k_1 values. The relations obtained for the variations of the k_1 and k_2 values relative to each other have been used for a computation of the activities of the components in solid solutions formed by KCl and KBr. AUTHOR.

See also Abstract 3876.

SURFACE TENSION AND COHESION.

3557. Surface Activity and Traube's Law. L. I. Weber and P. Sternglanz. *Zeits. f. phys. Chem.* 169. *Abt.A.* 3–4. *pp.* 241–259, 1934. —The method of capillary elevation is used to find the surface tension of water solutions, fatty acids and alcohols and from it to show that Traube's law which states that for the same surface tension in a weak solution, the ratio of the dilution for a homologous series is as $1 : 3 : 3^2 \ldots$, is verified, although there are marked deviations from it in certain cases. Measurements are also made with isomeric substances having branching chains and the validity of the law sought in this region. H. M. B.

TIME (STANDARDS, MEASUREMENTS, APPARATUS.)

3558. Equal-Altitude Time Determination with Impersonal Micrometer. Edmée Chandon, E. Bouty and A. Gougenheim. *Comptes Rendus*, 199. *pp.* 184–186, *July* 16, 1934.—An impersonal micrometer for equal altitudes, devised by R. Baillaud, is applied to a Jobin instrument of the geodesic pattern; an improved driving motor is used. The clock corrections derived are tabulated against those employed for the semi-definitive corrections of the International Time Bureau; the comparison is very favourable considering the small size of the instrument used; tests with larger instruments are contemplated. T. L. M.

3559. Coincidence Registration. H. Martin. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 269–273, 1934.—The application of coincidence registration methods [see Abstract 1469 (1932)] to testing the effect of varying the period of contact of the impulse action on a pendulum-clock is considered. An account of tests made with a Riefler clock pendulum is given, and reference is made to further tests as yet incomplete. The method promises to reveal useful information in connection with precision time-keeping. E. L. J.

3560. Photographic Time Registration on a Falling Plate in an Experimental Determination of "g." E. Langton and E. Tyler. *Phil. Mag.* 18. *pp.* 352–365, *Aug.*, 1934.—Methods of recording a time base on a falling photographic plate in an experimental evaluation of "g" are described, employing the use of (*a*) synchronous motor and slotted disc, a.c. mains controlled, and (*b*) flashing "Osglim," operated by either the a.c. mains supply or valve oscillator. Typical traces obtained by each of the methods are included, together with computed values of "g." Certain aspects of the glow condition of the "Osglim" under a.c. and d.c. voltage superposed are also considered, interpreting the photographic effects obtained. AUTHORS.

See also Abstracts 3475, 3490, 3829.

VACUA, HIGH.

3561. Induction-Heated Mercury Condensation Pump. L. Boddy. *Rev. Sci. Instruments*, 5. *pp.* 278–281, *Aug.*, 1934.—An improved boiler design for mercury condensation pumps, which possesses some marked advantages over the usual type, has been described. The induction heated boiler, while somewhat bulky and more difficult to fabricate than those of simpler construction, is capable of generating mercury vapour smoothly and quietly, meeting any pressure requirement over a wide range. This method of vapour generation is susceptible to close control with a very effective use of power, and at the same time subjects the glass of the apparatus to a minimum of thermal stress. AUTHOR.

3562. Outgassing of Graphite. I. A. Eltzin and A. P. Jewlew. *Phys. Zeits. d. Sowjetunion*, 5. 5. *pp.* 687–705, 1934. *In German.*—The expulsion of gas from Acheson and Wesselowsky graphites, and from Kudinow charcoal is investigated experimentally by subjecting small cylindrical specimens to heat treatment in high vacua. Two stages are distinguishable, in the first of which the gas adsorbed at the solid surface is rapidly emitted; after which diffusion from the interior ensues more slowly. The charcoal both absorbs and emits gas more easily than the graphites. Preparation of the specimens in an atmosphere of H_2 not only

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does not accelerate the emission, but may hinder it. Analysis of the gases emerging show that those adsorbed at the surface contain CO_2, 34 % ; CO, 58 % ; N_2, 8 % ; and those from the interior, CO, 68 % ; N_2, 32 %. While it is impossible to outgas a specimen completely, it is best to heat *in vacuo* for two or three hours at 1300° to 1500° C. ; exposure to air for 24 hours, cold, has then little effect, and subsequent outgassing at say 800° C., as required for mercury-vapour rectifiers, is easier. J. P. A.

3563. Pirani Gauge. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 221–223, *June*, 1934. *In English.*—Continuing previous work [see Abstract 3958 (1933)] the author used envelopes of silvered, black enamelled and plain glass. Observations on the heat supply to the filament shewed anomalies in the radiated energy (E_0), for E_0^2 (black enamel) was found to be greater than E_0^2 for silvered glass, which in turn was greater than E_0^2 for glass only. Applying black-body formulæ to the enamelled enclosure, and noting that the silvered surface is reflecting and the glass highly absorptive, the radiated energy for glass only should be greater than for silvered glass. This appears to suggest that the silvered surface absorbs heat rays more than the glass surface. The work is being continued. G. E. B.

3564. Grid-Current Control of the Ionisation Gauge. W. P. Overbeck and F. A. Meyer. *Rev. Sci. Instruments*, 5. *pp.* 287–289, *Aug.*, 1934.—The application of a saturable-core transformer to the control circuit of an ionisation gauge for the purpose of maintaining constant electron current from filament to grid has proved successful. AUTHORS.

VISCOSITY, FRICTION AND LUBRICATION.

3565. Viscosity of Sulphuric Acid and its Chloro-Derivatives. G. P. Lutschinsky. *Zeits. f. phys. Chem.* 169. *Abt.A.* 3–4. *pp.* 269–274, 1934.—The formula, developed by Batschinsky in which the viscosity of a liquid is connected with the specific volume, is applied to sulphuric acid, chlorsulphonic acid and sulphuryl chloride. The results confirm the applicability of the formula. Specially constructed viscometers were employed to suit the various liquids. The dependence in each case on temperature was determined. F. J. B.

3566. Viscosity of Water Vapour at High Pressures. W. Schugajew. *Phys. Zeits. d. Sowjetunion*, 5. 5. *pp.* 659–665, 1934. *In German.*—The Rankine capillary method is used to measure the viscosity of water vapour at pressures up to 93 atmospheres and temperatures up to 400° C. It is found that, within the limits of experimental error, the viscosity is independent of the pressure and increases linearly with temperature over the range investigated. The results are in agreement with those of other workers. H. J. H. S.

3567. Viscosity of Strong Electrolytes. W. M. Cox and J. H. Wolfenden. *Roy. Soc., Proc.* 145. *pp.* 475–488, *July* 2, 1934.—A modified capillary viscometer is described which, when used in conjunction with a new differential technique, may be employed to measure the relative viscosity of dilute solutions to 1 part in 40,000. The viscosity of aqueous solutions of magnesium sulphate and lanthanum chloride, of tetraethylammonium picrate in water, and nitrobenzene, and of sodium iodide in ethyl alcohol have been measured over concentrations ranging from

M/5000 to *M*/100. The results have been compared with the Falkenhagen equation. The coefficient B of the Jones-Dole equation has been evaluated for a number of uni-univalent electrolytes in aqueous solution, and has been shown, to a first approximation, to be made up additively of two quantities characteristic of anion and kation. The phenomenon of "negative viscosity" is discussed, and an explanation of the abnormal temperature coefficient of mobility in ions is suggested. It is also shown that Stokes' law must lead to erroneous results for a large number of ions.

AUTHORS.

3568. Viscosities of Aqueous Solutions of Electrolytes. Part I. H. M. Glass and W. M. Madgin. *Chem. Soc., J. pp.* 1124–1128, *July*, 1934.—Viscosities of sodium sulphate solutions have been measured at various temperatures from 25° to 40° and over a range of concentrations extending up to as near saturation as possible. No evidence of a definite transition of hydrates in solution, comparable with the change which occurs in solid hydrated sodium sulphate at about 32·5°, has been found, but the existence of a less definite form of hydration is presumed. The viscosity-temperature curves for each concentration are discussed, and a probable explanation of their slopes is given in terms of hydration of solute and depolymerisation of solvent. It is concluded that there is a progressive increase in total hydration of solute as temperature is lowered. The equation $\eta = 1 + A\sqrt{C} \pm BC$ has been applied to dilute solutions at 25°, and a value for A has been found which agrees satisfactorily with that calculated by applying the theory of Falkenhagen and Vernon.

AUTHORS.

3569. Direct Reading Viscometer. *Engineer*, 158. *p.* 95, *July* 27, 1934.—A short description is given of a new viscometer, claimed to be the first direct-reading type, designed by G. J. A. Rhodin. The method of measurement depends upon the viscous drag exerted upon the walls of a movable body placed in a channel through which the fluid under test is caused to flow at a predetermined velocity. The body is capable of motion in the direction of flow, whereby it bears upon a spring and actuates the pointer device. For absolute measurements the spring is replaced by a special type of gravity-controlled balance which enables the viscous drag to be measured directly.

L. A. W.

See also Abstract 3661.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

3570. Diffraction Theory of the Knife-Edge and Phase-Contrast Tests for Mirrors. F. Zernike. *Physica*, 1. *pp*. 689–704, *June*, 1934. *In German.*—The author goes further into the theory of his new method for testing concave mirrors [see Abstract 2366 (1934)]. On the basis of Abbe's diffraction theory of the formation of optical images, the appearance of a concave mirror with arbitrary small deviations is computed for the Foucault knife-edge test and the Zernike phase-contrast test. The theory of the functions suitable for expressing the errors of the mirror surface, the "orthogonal circle polynomials," is developed; their application is also developed more fully than in the previous papers.
T. L. M.

3571. Compensation of Birefringence in Telescope Objectives. A. Couder. *Comptes Rendus*, 199. *pp*. 27–29, *July* 2, 1934.—Residual birefringence in large objectives can be corrected by a plane parallel sheet of spar, protected by thin crown glass; by giving the outer surface of the glass towards the objective a suitable curvature the compensation extends throughout the field. Such a compensating device has been attached to the large Strasburg equatorial with extremely good results. T. L. M.

3572. Ultra-Violet Stellar Spectra with Aluminium-Coated Reflectors. Part I. S. L. Boothroyd. *Astrophys. J.* 80. *pp*. 1–6, *July*, 1934.—A short bibliography and historical résumé of the application of the evaporation process to astronomical mirrors is given. Apparatus and observing conditions at the Lowell Observatory and at their mountain station are described. There were obtained 174 spectra of 97 stars, for the most part to the ultra-violet limit of atmospheric transmission. [See following Abstract.] AUTHOR.

3573. Ultra-Violet Stellar Spectra with Aluminium-Coated Reflectors. Part II. R. C. Williams. *Astrophys. J.* 80. *pp*. 7–18, *July*, 1934.—Apparatus and methods of obtaining spectra for the analysis of the energy-curves of early type stars from λ 4350 to λ 3000 are discussed. The value of using an ultra-violer filter for stellar spectra, for intensity marks, and for solar spectra, for the determination of atmospheric absorption is mentioned. Microphotometer-curves of typical spectra are reproduced. Values determined for the atmospheric transmission above flagstaff are given. The Huggins bands of ozone are re-identified The method used for obtaining stellar temperatures from the energy-curves is outlined, and a table of the temperatures determined for fourteen stars is given. The energy-curves of three stars apparently having no continuous hydrogen absorption are shown. Suggestions are made for methods to segregate the superposed effects of (1) hydrogen absorption, (2) possible deviation of stellar energy-curves from that of a black body, and (3) possible Rayleigh scattering. [See preceding Abstract.] AUTHOR.

See also Abstract 3558.

COMETS AND METEORS.

3574. Continuous Spectra of Comets. F. Baldet. *Comptes Rendus*, 199. *pp*. 31–33, *July* 2, 1934.—Two types of continuous cometary spectra have been distinguished by Bobrovnikoff, according to the position of maximum intensity. The author, using spectrograms of greater relative purity for several of the same comets, attributes the difference to monochromatic images of the head superimposed on the continuous spectrum. A group in the violet reaches a maximum while the comet is still distant from the sun, then fades relatively to the CN bands, so giving the two types. The author does not exclude the presence of a continuous spectrum emitted by the comet, but considers its analysis impossible until slit spectra can be used. T. L. M.

3575. Interpretation of Cometary Phenomena. Part I. K. Wurm. *Zeits. f. Astrophysik*, 8. *pp.* 281–291, *July* 15, 1934.—An estimate of the pressure in and surrounding the head of a comet is made. A comparison of the free path, acceleration by light pressure, and probability of dissociation of molecules liberated in the head, gives an explanation of some differences between emission in the head region and the tail. The probability of a molecule reaching the outer regions of the head is greater close to the sun than at the distance of the earth. The same theory therefore accounts for the contraction of the head during and after perihelion. The frequent formation of luminous envelopes surrounding the head is also accounted for. T. L. M.

3576. Mass and Velocity of Meteorites and the Air Density along Their Luminous Paths. W. J. Fisher. *Harvard Coll. Obs., Circ. No.* 385. [16 *pp.*], 1934.—Previous theories are discussed. It is then assumed that the rate of loss of mass at any moment is proportional to the rate of loss of kinetic energy at that moment due to loss of velocity, *i.e.*, $\mathrm{d}m/\mathrm{d}t=\mathrm{k}m/H\{\mathrm{d}(\frac{1}{2}v^2)/\mathrm{dt}\}$, where H is the total heat of fusion, m and v the momentary solid mass and velocity (in km./sec.) respectively, and k and c constants, whence by integration and assuming 1 as the velocity at which melting ceases, $m=m_0e^{k(1-v_0^2)/2H}$, v_0 being the initial velocity of the meteorite. Meteorites are generally oriented and their paths straight, though occasionally helical. A formula for the relation between velocities, masses and air densities along the ablation path is then deduced, but involving two indeterminable constants. It is concluded that resistance of the air practically destroys the cosmical velocity of the meteorite, so that its velocity on reaching the earth is merely that of a falling body ; and that the explosions that occur in some cases are due to differential pressure of the air on different portions of the meteorite, the larger portions then naturally travelling further horizontally. [See Abstract 992 (1934).] C. A. S.

See also Abstract 3627.

COSMOGONY.

3577. Contracting Universe. E. Sevin. *Bull. Astronomique*, 8. 6. *pp.* 307–335, 1933.—A system of cosmogony is put forward based on the initial assumption that the universe is composed of a medium, the ether, which may occupy a closed region of space whilst space itself is not necessarily closed. A non-statical universe involves contraction of its radius, and the displacement to the red of the spectral lines of distant objects is explained by the assumption that the velocity of light decreases more rapidly than contraction of distances takes place. The author claims that difficulties of time-scale in stellar evolution are avoided by his theory. G. C. McV.

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DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstract 3584.

LATITUDE AND LONGITUDE.

3578. Longitude of Bordeaux Observatory. L. Pourtau. *Bull. Astronomique,* 8. 6. *pp.* 373–377, 1933.—Eleven series of observations (Paris time signals and meridian observations; details are given) lead to a result −2 m. 6·602 s. with a very small probable error, and confirm an unexplained error of a whole second in the previous astronomical determination. T. L. M.

3579. Determination of Latitude. G. L. Andrissi. *Accad. Lincei, Atti,* 19. *pp.* 635–639, *May* 6, 1934.—By way of example, applying Struve's methods to tabulated data and star observations on the prime vertical, the author works out that the latitude of the instrument at the Campidoglio observatory is 41° 53′ 33″·40. A. D.

3580. Variation of Longitude. M. Miyadi. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 249–252, *May,* 1934. *In English.*—Observations of time signals during 1929–1931 are analysed for the effect of the motion of the pole. Tokyo, Washington and a number of European observatories are used. The predicted variation of longitude is derived from the components of the polar motion and plotted with the observed residuals; the latter have in general greater range; both Tokyo and Washington give the annual term; Tokyo only gives the 14-months period clearly. The author concludes that with a better distribution of observatories the components of the polar motion can now be found from longitude observations. T. L. M.

NEBULÆ.

3581. Ultra-Violet Lines in the Spectra of Certain Planetary Nebulæ. W. H. Wright. *Lick Observat., Bull. No.* 459. *pp.* 1–4, 1934. —A study of the nebular lines on the more refrangible side of λ 3450, by means of the Crossley reflector, in which Al has been substituted for Ag. A table is given of 9 lines between λλ 3133·0 and 3444·1, measured in 1934. Of these, 5 lines which were also measured in 1918 may be segregated into two groups by peculiarities of their occurrence in nebulæ: namely, λλ 3346, 3426, and λλ 3313, 3342, and 3445. A plate is given in illustration. The members of the first group are now identified as NeV forbidden lines. Several aspects of the problem of nebular radiation are elucidated. A. S. D. M.

3582. Angular Diameters of Bright Galaxies. H. Shapley. *Harvard Coll. Obs., Ann.* 88. 4. *pp.* 93–103, 1934.—In the general photometric survey of extra-galactic systems brighter than the 13th photographic magnitude, the long-exposure Bruce plates show that angular dimensions are systematically too small, and the difference between spiral and spheroidal systems is markedly diminished. The ratio of the microphotometer to the Mt. Wilson measures (for 15 galaxies) is 4·1, and there is no reason to suspect that the microphotometric diameters are too large. A figure shows the correlation of "average-system" distance P, as derived from diameters, with photographic magnitude. In the mean, the Bruce photographs make spiral system diameters 63 % larger, and spheroidal system diameters 220 % larger than the records from the plates taken by the reflector. A. S. D. M.

3583. Orientation of Planes of Spiral Nebulæ Inferred from Dark Lanes of Occulting Matter. B. Lindblad. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* **24***A. No.* **21.** *pp.* **1–7, 1934.** *In English.*—From such orientation the writer suggests through theoretical considerations that the nebular spiral arms are asymptotic, defining approximately orbits of individual particles, or (if plume-shaped) the spiral matter lagging behind the rotation of points of ejection on the nuclear mother system; in the alternative cases the rotation is directed towards the concave or the convex sides of the spirals respectively. He points out that where (as in M51) the narrow strips of dark matter occur along the inside of the bright spiral arms, they are on the further side of the apparent ellipse. It is possible that the dark clouds are driven away from the nucleus; such seems to be the case for nebulæ with dark "secondary" lanes near the central nucleus. He illustrates the condition schematically, and concludes that the faint side containing the most intense lane (as in M31) is the one more distant from us, and comparing with the direction of rotation as given by Pease, that the spiral arms are asymptotic, opening up their *concave* sides in the direction of rotation. A. S. D. M.

PLANETS.

3584. Asteroid Perihelia. J. Mascart. *Comptes Rendus,* **199.** *pp.* **260–261,** *July* **23, 1934.**—Among the general tendencies of minor planets, the author notes that the orbit is generally more eccentric under strong perturbation by Jupiter and for certain distances tends to have its axis towards the perihelion of Jupiter. He studies the departure of the planet from its mean position, and obtains an expansion for the relation between this departure and the planet's elongation from Jupiter. The case is throughout that of a planet in the plane of Jupiter's orbit. The general expansion for the departure cannot be extended into the most critical regions (Hecuba type, etc.); the computations will be published in full. T. L. M.

3585. Atmospheres of Giant Planets. A. Adel and V. M. Slipher. *Nature,* **134.** *pp.* **148–149,** *July* **28, 1934.**—An investigation of the extent to which the methane molecule (CH_4) is responsible for the spectrum of the major planets. The prominent overtone sequence of the V_3 fundamental at $3 \cdot 3\mu$ [see Abstract 1219 (1931)], coincides precisely with the outstanding group of absorption bands in the spectra of the giant planets and (for these and the moon) a figure gives a comparison for this region. Not all of the methane bands have, as yet, been seen in the laboratory, as the absorption columns in Neptune and Uranus are of a greater order than the laboratory path length available. The authors deem it likely that the giant planets have a predominantly hydrocarbon nature. There is now probably almost maximum stability relative to the physical conditions which prevail in the planetary atmospheres. A. S. D. M.

STARS.

3586. Russell Diagram and White Dwarfs. J. Tuominen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* **24***B. No.* **9.** *pp.* **1–4, 1934.** *In English.*—A study of the frequency of absolute magnitudes in different parts of the Russell diagram for a space of 10 parsecs radius. Russell diagrams are constructed up to trigonometrical parallaxes of 0″·095 and 0″·094–0″·070. These exhibit several stars situated strikingly below the main series, of which three are well-known white dwarfs. A table is given of 11 stars, of which 7 are white dwarfs and 4 are probably so; it includes their proper motion, apparent visual magnitudes, adopted parallaxes, absolute magnitudes and spectral classes. A second table gives the relative parallax, probable error, etc., of the KO star, Wolf 1056.

A. S. D. M.

3587. Motion of A-Type Stars and Galactic Rotation. C. Bertaud. *Bull. Astronomique*, 8. 6. *pp*. 337–372, 1933.—The material has already been described and preliminary results published, with the discussion in detail of the stars belonging to the Ursa stream [see Abstracts 5209 (1933), 110 and 1011 (1934)]. The material consists of space velocities computed from parallax, proper motion and radial velocity; the catalogue (527 stars) and sources are now given in full. The Taurus stream is discussed in detail; for 41 stars the residual velocity or difference from the mean stream velocity does not exceed 12 km./sec. There is a strong concentration at about 40 parsecs from the sun, which gives the coordinates of the central part of the stream; most of the members of the stream lie close to the galactic plane. The velocity plots for the whole of the data are given; the results are computed throughout for the whole and also with elimination of the two streams. The sun's apex is 263°·4, + 22°·0, velocity 12·9 km./sec. for the whole (267°·8, + 20°·7, 14·2 km./sec. without the streams). Previous results are compared; the declination is unusually low. The whole is fully analysed for the suggested dependence on distance from the galactic plane, with results which are largely negative. The X-component is affected by the streams, the others only slightly. The distribution of the projections of the velocities on the galactic plane is also analysed. The values of the Oort constants are nearly twice as large as for other spectrum types and the longitude of the centre 25° instead of 330°. The author suggests that this may be due to the limited field, not exceeding 160 parsecs, covered by the data.

T. L. M.

3588. Variation of Velocity Ellipsoid over the Galactic Plane. H. Mineur and H. Camichel. *Comptes Rendus*, 199. *pp*. 262–263, *July* 23, 1934.—Velocity ellipsoids are found for giant stars of types G, K, M. (the two former types in two sub-groups each) from the galactic coordinates and corresponding velocity components, these stars are then distributed over nine areas of the galactic plane, each a square of side 100 parsecs, and the velocity ellipsoids re-computed. The direction of the vertex appears constant for the field studied. The alternative hypotheses of velocities towards a fixed point and of velocities at right angles to the line to a fixed point are not supported; but this only shows that any centre of rotation is comparatively distant. The velocity figure is however more circular in the galactic plane for the limited fields than for the whole region. T. L. M.

3589. Proper Motions of Stars in the Region of Cluster M13. Violet F. White. *Roy. Astron. Soc., M.N.* 94. *pp*. 783–787, *June*, 1934. —Two plates centred on the Great Cluster in Hercules, which were taken at an interval of 36 years with the Wilson reflector of the University of London Observatory, have been measured for proper motion. The result for the cluster is so small that it may be assumed to be zero. A figure

constructed from the drift curve drawn for stars outside the cluster shows the directions of Drift I and II and of the solar antapex; and a table gives the numbers of stars with centennial proper motions between various limits.
M. A. E.

3590. Interferometric Determinations of Wave-Lengths of Silicon Lines Occurring in B- and O-Type Stars. C. V. Jackson. *Roy. Astron. Soc., M.N.* 94. *pp.* 723–726, *June,* 1934.—The wave-lengths of the ten brightest lines of silicon occurring in stellar spectra of class B and O have been measured interferometrically with an accuracy of 0·001 Å or 0·002 Å, by comparison with the secondary standards of krypton.
AUTHOR.

3591. Paschen and Balmer Series in Stellar Spectra. P. W. Merrill and O. C. Wilson, Jr. *Mt. Wilson Observat., Contrib. No.* 494. *Astrophys. J.* 80. *pp.* 19–50, *July,* 1934.—The authors give results for higher members than the first 3 or 4 lines of the Balmer series and (for the first time) make available comparable data for the Paschen series. A table and plate are given and typical microphotometric traces are drawn. Most of the lines exhibit less absorption than should be given from an exponential wing form; for several stars Paschen mean contours are compared with the Balmer series. A table is given of the total absorption in hydrogen lines in α Cygni, β Orionis and α Leonis with a diagram of the relative numbers of atoms in the 2nd and 3rd energy states from which their temperature may be computed. From the relative intensities of the two series, arising by transition from the same upper levels, the authors show that certain conclusions can be drawn concerning physical conditions in the hydrogen atmosphere and the effective temperature of the photosphere, and they outline the theory. With better photometric data the method may yield valuable information concerning space absorption; its application to abnormally coloured Be stars should be particularly interesting.
A. S. D. M.

3592. Spectrum of β Lyræ. Helen M. Pillans. *Astrophys. J.* 80. *pp.* 51–58, *July,* 1934.—The wave-lengths of 240 absorption lines in the spectrum of the B8 component of β Lyræ are given. Of these, 176 are identified with H, He I, Ca II, Si II, Si III, Cr II, Sc II, Ni II, Mg II, Fe I, Fe II, Ti II, Sr II, S II, N II, and V II. A comparison of this component of β Lyræ with the supergiants β Orionis (B8 p) and σ Cygni (Aop) is made, with the result that the so-called B8 component is found to be normal for the later class of B9. The lines in the spectrum of the B5 component are compared with those in the spectrum of 67 Ophiuchi (B5) and, as many important B5 lines are missing, the conclusion is reached that the B5 spectrum is not normal for its class. A plate with phase $0^{d}.38$, which showed exceptionally strong H and He emission, showed also additional emission lines not seen at other phases. These are identified with N II 4621, N II 4630, N II 4643, and Mg II 4481.
AUTHOR.

3593. Forbidden Helium Line λ 4470. O. Struve. *Astrophys. J.* 80. *pp.* 64–65, *July,* 1934.—Several arguments are given in favour of the identification of the stellar absorption line at λ 4470 with the forbidden helium line $2p-4f$.
AUTHOR.

3594. Stellar Colour Temperatures and Absorption Coefficient. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 94. *pp.* 713–722, *June,* 1934.—The ionisation temperature of Ao stars is found to be much lower than the colour temperature. Eddington's discussion suggests that the latter should not differ greatly from the effective temperature for the sun; observation shows that it is considerably higher. The relation between the two temperatures depends on the variation of the coefficient of continuous absorption. The author shows that a high excess of colour temperature should imply high hydrogen absorption. Eddington's analysis is revised in detail so as to bring out the effect of absorption lines. The relation of the ionisation temperature to the other two is then discussed; it is shown to be intermediate between them both for the sun and for A stars. T. L. M.

3595. Stellar Absorption and Opacity. A. Ganguli. *Indian Journ. Phys.* 8. *pp.* 353–364, *April*, 1934.—The method used before for deriving Kramers' expression for X-ray absorption [see Abstract 1265 (1932)], has been extended and formulæ for the absorption and opacity coefficients for the non-relativistic case (classical and degenerate) and also for the relativistic case, have been obtained, in a simple and direct manner. It is shown that the opacity coefficient for the non-relativistic degenerate case is independent of density, whereas the same for the relativistic case is constant, being independent of temperature as well. Opacity coefficients for the bound-free transition have also been obtained and found to be negligible for the degenerate case. AUTHOR.

3596. Non-Static Hydrogen Chromospheres and Problem of Be Stars. B. P. Gerasimovič. *Roy. Astron. Soc., M.N.* 94. *pp.* 737–765, *June*, 1934.—Possible mechanisms producing dissipation of stellar atmospheres are reviewed; the author shows that in the atmospheres of some luminous B stars radiative acceleration overbalances gravitation for H atoms, leading to dissipation phenomena. The radiation field in the nebular layers of a schematic extended H chromosphere is analysed; from the mechanical state of such a non-static chromosphere conditions necessary for steady outflow are derived. The problem of the acquisition of an initial velocity and that of the limiting velocity of the first atoms of a new moving stratum are discussed. The theory is applied to the P Cygni characteristics and a model given. The theory cannot be applied directly to Bne stars; rotation appears to facilitate radiative dissipation, but this cannot be steady. The Bse problem is briefly commented on. An additional analysis of the transmission of radiation through moving media is appended. T. L. M.

3597. Stability of Gaseous Stars. T. G. Cowling. *Roy. Astron. Soc., M.N.* 94. *pp.* 768–782, *June*, 1934.—The problems of the convective and the vibrational stability of a star are discussed. It is found that with Kramers's opacity law convection will appear in a star in which the generation of energy per unit mass varies more rapidly than the eighth power of the temperature, and that the radial oscillations of a star in which convection does not appear will not increase indefinitely unless the ratio of specific heats of the material is less than 1·38. AUTHOR.

3598. Theory of Stellar Atmospheres. A. Unsöld. *Zeits. f. Astrophysik*, 8. *pp.* 225–266, *July* 15, 1934.—The physical properties of stellar material, assumed 1/3 H, 2/3 of the composition of the earth, are examined in relation to electron pressure and temperature; and the number of electrons per atom, the gas pressure, effective molecular weight, absorption co-efficients, and scattering by free electrons are discussed. From these considerations a theory of the continuous spectrum is developed. The theory of line contours is formulated. An approximate theory of stellar lines is then developed on the assumption that all physical quantities are constant throughout an atmosphere; this is applied to Ca and H. Two cases are fully worked out, those of the sun and the red giants. The approximate analysis proved sufficient at almost all points. A critique of the similar developments of Milne is appended. Russell's conclusion that H is 1000 times more plentiful than all the metals combined is considered. The author sees no reason to abandon the ratio 14 : 1 given by the theory of the internal constitution of a star; and regards this value as not far from the true ratio. T. L. M.

3599. Gravitational Centre of Galaxy from Motions of O5 to B7 Stars. J. S. Plaskett and J. A. Pearce. *Roy. Astron. Soc., M.N.* 94. *pp.* 679–713, *June*, 1934.—The paper is based on ten years observations of the most luminous stars at Victoria, Canada. 849 radial velocities are available, and are cleared of the B-type southern stream, whose motion is recomputed. The general solution for the common solar motion is V = 19·09 km./sec. towards Lo 21°·4, Bo — assumed +20°, agreeing well with values from the stars in general. The K term is reduced to +1·13 km./sec.; a calculation of the Einstein displacement gives almost this value; the term is regarded as satisfactorily explained. The galactic rotation terms, whose introduction leads to the reduction of the K term, give the direction of the centre as 324°·4. The proper motions of 881 stars give mean parallaxes and absolute magnitudes. The proper motions are corrected for known systematic motions, solar motion, etc., and the corrections to Newcomb's precession computed. The rotational constant A derived from the radial velocities is adopted, that from the proper motions agreeing reasonably well, and B is found from the proper motions. The rotational velocity at the sun is adopted as 275 km./sec. The distance of the centre of the galaxy is found to be 10,000 parsecs., agreeing well with that of the centre of the globular cluster system when corrected for Stebbin's space absorption by colour excess. The diameter of the galaxy, 30,000 parsecs., is practically the same as that of the faint extensions of the Andromeda nebula. The difficulty of the abnormal size of the galaxy disappears; it is not necessary to regard it as a congeries of nebulæ. The rotation period at the sun is about 224×10^6 years. T. L. M.

3600. Numerical Integration of the Integral Equation of Stellar Statistics. A. Brill. *Zeits. f. Astrophysik*, 8. *pp.* 271–280, *July* 15, 1934.—A method of numerical integration is given for the equation $a(m) = k\int_0^\infty D(r)r^2\phi(5+m-5\log r)dr$ where $a(m)$ is the number of stars in a square degree between apparent magnitudes $m-\frac{1}{2}$ and $m+\frac{1}{2}$; $D(r)$ is the density of stars, assumed to depend only on distance; $\phi(M)$ is the frequency function of stars between absolute magnitudes $M-\frac{1}{2}$ and $M+\frac{1}{2}$ per cubic parsec in the neighbourhood of the sun, and k is a constant. G. C. McV.

3601. Light Curve of SS Cygni, 213843. L. Campbell. *Harvard Coll. Obs., Ann.* 90. 3. *pp.* 95–162, 1934.—A table is given of 44,000 observations. The light curve is plotted and shows the rise to maximum as less uniform than the drop to minimum. A second table gives the summary of maxima, also graphically represented. This indicates that the maximum magnitude is in general about 8·4; it may be 8·2, but sometimes is as low as 10·0 and the minimum magnitude is even more irregular, reading 11·8 as minimum average. The oscillations have a mean period of about 50 days but there is indication of long cycles of about 3000 days (or 60 cycles). A. S. D. M.

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3602. Problem of SS Cygni Variable Stars. G. R. Miczaika. *Zeits. f. Astrophysik*, 8. *pp.* 292–294, *July* 15, 1934.—For an attempt to indicate statistical relations in this type sufficient data are only available for 7 stars. The author suggests a relation between the period and rate of change of brightness ; a relation between the latter and the magnitude at maximum is doubtful ; in general, for large amplitude a small proportion of the period is taken up by the rise in brightness. A relation between these features and the curve types Z Cam, U Gem, and SS Cyg is doubtfully suggested. T. L. M.

See also Abstracts 3572, 3573, 3740.

SUN.

3603. Solar Chromosphere. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 94. *pp.* 726–737, *June*, 1934.—The analysis contained in a previous paper [see Abstract 536 (1934)] is generalised to take into account the effect of darkening. A first discussion of the equilibrium above a radiating surface with a two-dimensional variation of intensity is also made, and reasons are advanced for believing that the characteristics of the structure of the chromosphere derived on the basis of a model with a one-dimensional variation of flux will be true even if the problem were solved with sufficient generality. Finally, the physical premises underlying the theory are carefully examined. AUTHOR.

3604. Phosphorus in the Sun. Charlotte E. Moore, H. D. Babcock and C. C. Kiess. *Astrophys. J.* 80. *pp.* 59–60, *July*, 1934.—On the basis of spectroscopic evidence phosphorus may with some assurance be added to the long list of elements present in the sun. Three infra-red solar lines are attributed without question to phosphorus, and two with some doubt. The laboratory spectrum is discussed and a table gives the observable multiplets and corresponding solar data from which the results are derived. AUTHORS.

See also Abstracts 3629, 3710.

ZODIACAL LIGHT AND GEGENSCHEIN.

3605. Colour of the Zodiacal Light. C. T. Elvey. *Astrophys. J.* 80. *pp.* 61–63, *July*, 1934.—The colour of the zodiacal light has been measured on five nights with a photoelectric photometer and has been found to be variable. The mean colour is nearly that of the sun, which indicates that the scattering of the sunlight is by large particles.

AUTHOR.

GEOPHYSICS.

GEODESY.

3606. Mechanism of Polar Displacement and the Resulting Tracks of the Poles. M. Milankovitch. *Gerlands Beitr. z. Geophys.* 42. 1. *pp.* 70–97, 1934. *English Abstract.*—The author refers to his article in Gutenberg's *Geophysics*, in which it is shown that the sial covering, because of isostatic stratification and the power of adjustment of the earth under the influence of secular forces, is slowly displaced over the lower masses. The poles of rotation of the earth have a secular displacement relative to the sial covering. The curves of the polar tracks belong to vector lines of a well-defined vector field and are given by the opposed positions of the earth's poles. The fundamental equations of the mechanism of the secular polar displacements are deduced here by a new method and numerical calculations of the secular polar trajectories are added. The results are tabulated and the path of the N pole shown on a map. During the palæozoic age the N. pole was in the Pacific ocean far from the coast. It travelled east and then north, next across the north-east corner of America and then over the Arctic sea to its present position. The S. pole followed an antipodal path. The polar trajectories thus deduced agree satisfactorily with the results of geologists. R. S. R.

3607. Earthquakes and Axial Oscillations of the Earth. R. Spitaler. *Gerlands Beitr. z. Geophys.* 42. 1. *pp.* 98–109, 1934.—The author has attempted to find a relation between earthquake frequency and polar oscillations. 197 earthquakes in different parts of the earth are used. For tabulated values of the path expressed for each year and tenth the corresponding frequency of earthquakes is determined over certain ranges of phase of the axial oscillation. It is concluded that there is an undoubted connection between earthquake frequency and the position of the epicentre relative to the critical meridian. The earthquake frequencies in the Pacific, N. and S. America and in the Himalayas show important differences in relation to the critical meridian and the force distribution in the earth. R. S. R.

GEOPHYSICS, APPLIED.

3608. New Method of Electrical Prospecting. M. Müller. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 302–315, 1934.—The author describes a new method of determining the depth and thickness, etc., of the porous strata which are so important in connection with occurrences of water, oil and natural gas. A valve generating arrangement excites l.f. a.c. oscillations which pass through a valve rectifier, by-passed by a suitable condenser, to a pair of non-polarisable electrodes, whence the very l.f. pulsating currents so produced are sent into the ground. The effect of porous conducting strata is to create electrolytic reverse currents which react upon the rectifier and modify the nature of the pulsating current. In particular the ratio of the period of charge to that of discharge at the terminals serves as a measure of the polarisation currents so produced. Various other quantities can be measured to determine the electrolytic

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effects, and thereby permit conclusions as to the nature of the stratum to be drawn. The frequency of the excited pulsating current and the electrode separation are varied to provide additional information, and the electrode spacing gives a close indication of the depth of the stratum. An account of tests made in a well-known oil region is given, the indications regarding depth being valid to 2000 m. A partial theory of the method is given, and details of apparatus are outlined. Further particulars are promised. E. L. J.

3609. Current Distribution when the Resistivity is a Continuous Function of the Depth. L. V. King. *Roy. Soc., Phil. Trans.* 233. 728*A*. *pp*. 327–359, *July* 18, 1934.—The paper, which is an extension of a previous one [see Abstract 2005 (1933)], determines the surface gradient characteristic, defined by

$$\bar{\rho} = -\frac{2\pi r^2}{I}\frac{\partial V_s}{\partial r} = \frac{2\pi\rho_s}{I} r \left[\frac{\partial\psi}{\partial z}\right]_{z=0},$$

when the suffix s refers to surface values and ψ is the current function, for various cases in which the resistivity is a continuous function of depth only. Equations are developed for the current function in three general cases, and the potential function is also developed for one case. The results are applied to the determination of $\bar{\rho}$ for particular cases in which the resistivity varies in a known manner. In practice, the results are obtained with two current electrodes, while the theory is developed for one electrode only. If the measurements are made with two current bases, one being twice the other, it is possible to deduce the surface gradient characteristic due to one electrode. The results obtained for point electrodes are easily extended to line electrodes of any configuration and in particular to infinite straight line electrodes. It appears that the expressions for infinite line electrodes are more suitable for analysis than the corresponding formulæ for point electrodes. By graphical integration, using the observations obtained for point electrodes, the surface gradient characteristic for an infinite line electrode may be deduced and it becomes possible to determine the various constants by Prony's method of exponential analysis, and so obtain a complete solution of the field observations. J. M. B.

See also Abstracts 3518, 3634.

HYDROSPHERE, PHYSICS OF THE.

3610. Absorption of Light by Sea Water. E. B. Stephenson. *J.O.S.A.* 24. *pp*. 220–221, *Aug*., 1934.—The absorption coefficient of sea water for sunlight was measured by means of a portable photometer in the conning tower of a submarine at depths down to 65 feet in the open seas off Panama, Southern California and Hawaii during April to July 1933. From the formula $I = I_0 10^{-\gamma D}$, where I is in foot-candles and D is in feet, γ was found to have an average value of 0·008 ± 0·001 for clear open sea water. In Panama Bay, where the water is rich in animal and vegetable life, the absorption coefficient was 0·030. No evidence of polarisation of the scattered light was observable by rotation of a simple nicol prism. AUTHOR.

3611. Problem of Internal Tides. Parts III and II. O. Pettersson. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 24*A*. *No*. 16. *pp*. 1–30, *and No*. 17. *pp*. 1–16, 1934.—Part III precedes Part II and deals with the theory of the vertical tidal force. The author confirms the conclusion of Laplace that the vertical force has no effect on the surface of the hydrosphere ; but regards it as producing tides at surfaces of discontinuity of density within the ocean. The variation of vertical force from one part of the ocean to another produces tendencies to rise and fall in different regions and so an internal oscillation which is only recognisable at the discontinuity between a surface layer and the water of the depths. The computation of the amplitude of the oscillation is given in full. The author replies to criticism by M. Brillouin. Part II deals with certain evidence of internal circulation in the waters of the Great Belt, and the mechanism proposed by N. Zeilon, and also with oscillations observed in 1932 in the Cattegat. T. L. M.

3612. Probable Effect of Tidal Power Development on the Bay of Fundy Tides. H. B. Hachey. *Frank. Inst., J.* 217. *pp.* 747–756, *June,* 1934.—The tides in the Bay of Fundy have 175 million h.p. of available energy, whilst those of Passamaquoddy Bay have 2½ million. The tidal phenomenon of the Bay of Fundy is of the stationary wave type, and this combined with a progressive wave is responsible for the very large tides there. The stationary wave oscillations of the Bay of Fundy are not transmitted to Passamaquoddy Bay, and the closing of the latter will not affect the natural period of oscillation of the waters of the Bay of Fundy. The closing of Passamaquoddy Bay will result in additional energy being reserved to the Bay of Fundy and bring about increased tidal amplitudes. W. A. R.

See also Abstracts 3524, 3614.

LAND, PHYSICS OF THE.

3613. Deformation of Sand Mass. N. Miyabe. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 195–213, *June,* 1934. *In English.*—Previous experiments [see Abstract 86 (1930)] have been continued, but using in this case sand resting on a very viscous layer of " Midaume," having the same density as sand but a coefficient of viscosity of 10^4-10^5 c.g.s. units. The earlier apparatus was modified. Photographs of the sand mass were obtained at equal time intervals when it was deformed by lateral compression. The modes of deformation are described in detail and illustrated by photographs to show the slip lines and the development of step faults and folds. Comparisons are made with analogous geophysical phenomena in volcanic parts of Japan. R. S. R.

3614. Magnetic Properties of Ferromagnetic Minerals in Stones. J. G. Koenigsberger. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 385–394, 1934.—Eruptive rocks have a remanent magnetisation I_n of amount mostly, but not always, dependent on their geological age. Old rocks have often a weaker I_n and younger rocks a stronger I_n induced by the earth's field when cooled from their higher Curie point. The maximum apparent remanence and apparent susceptibility were measured for artificial powders of quartz mixed with magnetic, pyrrhotite, hematite, ilmenite and titanomagnetite respectively. By cooling in a known field the thermoremanence of the specimens was also found. G. E. A.

3615. Interaction of Clay with Liquids and Crumb Formation in Soils. E. W. Russell. *Roy. Soc., Phil. Trans.* 233. *pp.* 361–389, *Aug.* 14, 1934.—Clay particles have an appreciable interaction with the molecules of polar liquids ; they do not interact, or only slightly with non-polar liquids. On the hypothesis that no differential interaction occurs between the exchangeable ions on the clay and a non-polar hydrocarbon, the Mg ions on the clay have about seven and the Ca ions about three more molecules of water of hydration than the Na or K ions. Independent evidence is given for this conclusion. Clays interact with water and organic liquids containing a polar group by causing a contraction of the liquid. For homionic clays, saturated up to pH7 with base, this contraction is nearly proportional to the number and mean charge density on the surface of the exchangeable ions on the clay and, to a less extent, it varies with a parameter specifying the shape of the titration curve of the clay. These results have been interpreted on the hypothesis that kations can orientate polar molecules of the dispersion liquid around them, and this power is proportional to their surface density of charge. This power is also possessed by the free negative charges on the clay particle. When the dispersion liquid has nearly all been removed the kations bind the negative charges on two clay particles together by means of bridges of strongly orientated molecules of the polar dispersion liquid. AUTHOR.

3616. Colloidal Nature and Related Properties of Clays. W. W. Meyer. *Bureau of Standards, J. of Research,* 13. *pp.* 245–258, *Aug.,* 1934. —A theory is presented on the colloidal nature and related properties of clays, based upon the findings of certain soil scientists and the existing knowledge of the phenomena of coagulation, deflocculation, plasticity, drying, shrinkage, and dry transverse strength. It is thought that this paper will allay some of the present confusion of ideas concerning the subject of clay colloids by adaptation of this theory to furnish a more satisfactory explanation of the above phenomena. AUTHOR.

3617. Local Loading of the Earth's Crust with Special Reference to the Snow-load on the Alps. F. Steinhauser. *Gerlands Beitr. z. Geophys.* 41. 4. *pp.* 466–478, 1934.—A distribution of snow over the Alpine area with a maximum depth in the centre of 4 m. is assumed, and from it a vertical displacement of the earth's surface at the centre line of the loaded area of 3·99 cm. is calculated. At a distance of 1000 km. the vertical displacement is 0·38 cm. The weight of the water in Lake Neusiedl produces a deformation of 0·32 cm., and that of the city of Vienna 0·14 cm. W. A. R.

See also Abstracts 3606, 3692, 3693.

METEOROLOGY.

3618. Transparency of the Lower Atmosphere and its Ozone Content. D. Chalonge and E. Vassy. *J. de Physique et le Radium,* 5. *pp.* 309–319, *July,* 1934.—The ultra-violet spectrograph used has a prism objective of a new type which with a distant point source gives a spectrum of great fineness which is important in spectrophotometric researches. Astigmatism is given to the optical system by inclination of the objective and the tangential foci are photographed. The coefficients of absorption of the atmosphere in the ultra-violet are obtained by measuring by photographic photometry the absorption produced by air 1200–1400 m. thick on rays from a hydrogen tube. The two hydrogen spectra are compared for sources at 400 m. and 1600–1800 m. distance. These spectra show for wave lengths < 2700 Å an absorption attributable to molecular oxygen formed by a band spectrum and followed below 2421 Å by a continuous spectrum. Dealing with absorption in regions outside that where absorption by oxygen occurs the ozone content can be determined. From simultaneous observations at Lauterbrunnen (800 m.) and Jungfraujoch

(3457 m.) the ozone content is found to increase with height and the ozone is widely distributed. Also the atmosphere at Lauterbrunnen seems to be more absorbing below 2500 Å than at Jungfraujoch. The authors consider that at least in layers distant from the ground small quantities of a body exist whose nature requires to be elucidated. R. S. R.

3619. Reversal Effect with Atmospheric Ozone Measurements. F. W. P. Götz. *Zeits. f. Astrophysik*, 8. *pp.* 267–270, *July* 15, 1934.—A knowledge of the vertical distribution of ozone is of importance in finding the rôle of O, O_2, and O_3 in the upper atmosphere. Solar measurements in practice give the equivalent height and not the vertical distribution of O_3. With increase of zenithal distance (z) the intensity (I) for the wave 3110 Å decreases more rapidly than that (I_1) for the wave 3290 Å. At $z=85°$ the zenithal light is a maximum and then I/I_1 reverses its change. Expressing I/I_1 as a function of z the vertical distribution of O_3 is obtained. Pekeris found no reversal effect [see Abstract 1935 (1934)]. The author supplies the reason for this and shows mathematically how the reversal effect may be explained. R. S. R.

3620. Polar Front and the Formation of Typhoons. C. Poisson. *Comptes Rendus*, 199. *pp.* 159–160, *July* 9, 1934.—On the coasts and on the island of Madagascar violent disturbances often occur, their development taking place in less than 48 hours. The origin of these has been attributed to a front between the monsoon and the trade winds. Now V. Bjerknes has shown recently that the conditions necessary for development of such rotating disturbances occur only when the surface of the separation strikes the ground. Also the tropical cyclone follows the edge of the current from the polar front. The front so conceived is then temporary and the front exists only so long as the monsoon reacts on the trade wind. The question arises whether this type of front should be treated by Bjerknes' method of analysis or by that of Exner. The author puts forward the above hypothesis as to origin as one that has been found useful in several ways. A. E. M. G.

3621. Föhn Wind Cyclo-Genesis. I. P. Krick. *Gerlands Beitr. z. Geophys.* 42. 1. *pp.* 56–69, 1934. *In English.*—If sufficient temperature differences exist, then regions of cyclo-genesis arise where convergent flow occurs between air masses of different characteristics. In autumn and winter such a region exists in America where föhn winds from the Columbian plateau, warmed by their descent, form the warm currents. These interact with the cold air from the Canadian provinces to form well developed cyclones. These cyclones, though intense, may give little precipitation as the warm air is dry. They move in a south-easterly direction and a continual series is generated so long as the Columbian plateau anticyclone is maintained. These disturbances move more rapidly than the normal cyclones. Examples of these storms occurring between 9th and 15th November, 1933, are discussed, and illustrated by charts. A. E. M. G.

3622. Meteorological Results of the British Arctic Air Route Expedition 1930–1931. S. T. A. Mirrlees. *Meteorolog. Office, Geophys. Mem.* No. 61. [61 *pp.*] 1934.—Here the meteorological observations made at sea-level at the base station 30 miles west of Tasiusak and at an inland station 140 miles N.W. of the base station and at an altitude of 8000 feet are summarised. Visibility, cloudiness, wind, gale frequency, precipitation, pressure distribution, optical and other phenomena are dealt with, all illustrated by tables and diagrams. A copy of the entries in the weather register for both stations is given in the Appendix. A. E. M. G.

3623. Chlorine Distribution and Groups of Drops in Fog. Calculation of the Colour of the Corona in White Light. Critical Remarks on the Coagulation Theory of Fog Drops. H. Köhler. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 24*A. No.* 9. *pp.* 1–50, 1934. *In German.*—Lipp and Lauscher obtained results on the analysis of hoar frost which made it important to study the chlorine distribution in fog, this problem having a close connection with the drop distribution in clouds and probably also in rain. Niederdorfer's results on drop distribution in rain agree well with those found by the author in fogs. The author shows that the chlorine distribution in rain is nearly the same as in hoar frost and the distribution of drops can be expressed in the form $r = B_i\ 2^{n/3}$ where r is the radius of the drop of size B_i arranged in i groups and $n = \pm\ 0, 1, 3, 4, 5 \cdots\cdots$. Four groups were established 2-, 3-, 5- and 7-groups. These results were supported by calculations and measurements of the colour intensity and brightness of coronæ formed artificially by various particles or naturally in fog and cloud by point or larger sources of light. The views were also supported by measurements of the mass distribution of drops. The author then reviews critically the coagulation theory of drops in fogs and clouds and points out the difficulties in accepting it. Finally V. Bjerknes' theory of forces between regularly polarised spheres accounting for coagulation of drops of equal sizes in fog or cloud is shown to have errors in the calculations. R. S. R.

3624. Mean Turbidity of the Air. F. Steinhauser. *Gerlands Beitr. z. Geophys.* 42. 1. *pp.* 110–121, 1934. *English Abstract.*—Mean values of Linke's turbidity factor were calculated for 53 stations spread over the northern hemisphere and a few also in the southern hemisphere, for January, July, the four seasons and the year. Grouping stations with almost equal degrees of turbidity it was possible to deduce the turbidity factor for country air, air of large cities and of mountain air (1800 m. high and for middle latitudes). Using these mean turbidity factors as a basis, the diurnal variation of the radiation intensity and the daily sum of the solar radiation were calculated for 50° latitude and for the three types of air mentioned. The intensity of radiation falling upon a surface normal to the direction of the radiation was calculated for the 15th of each month. For some stations of low latitude the yearly variations of the factor of turbidity are given. For comparison some turbidity factors are added based on observations made during sea voyages. R. S. R.

3625. Climatic Conditions Indoors. K. Kähler. *Naturwiss.* 22. *pp.* 461–463, *July* 6, 1934.—30,000 observations were made at Davos over a period of 12 months by Egloff and are discussed in the paper. The factors dealt with are (1) temperature, governed by internal regulation, (2) humidity, little different in summer from outside values but affected by ventilation in winter, (3) magnitude of cooling, determined by a frigorimeter, (4) brightness, measured by a photometer and expressed photochemically, (5) dust content, measured by an Owen's counter and diurnal and monthly changes given, (6) numbers of condensation nuclei, measured by Aitken's counter and large numbers found in this valley, and (7) numbers of light, medium and heavy ions and their sign and diurnal variation found. No excess of negative ions was found with föhn winds at Davos. Finally, the favourable influence of ionic numbers is discussed. R. S. R.

3626. Spectrum of the Night Sky, 2900 to 4100 Å. J. Gauzit. *Comptes Rendus,* 199. *pp.* 29–31, *July* 2, 1934.—The paper extends the work of Cabannes [see Abstract 3219 (1934)] into the region from 2900 to 4100 Å with the quartz spectrograph, exposure up to 55 hours. 110 lines are tabulated, and a number identified with He, A and the spectrum of cometary nuclei. Emission lines appear to be present in the region of the great ozone absorption band and should be confirmed. T. L. M.

3627. Cosmic Influence on the Upper Strata of the Atmosphere. C. Hoffmeister. *Naturwiss.* 22. *pp.* 458–460, *July* 6, 1934.—A study of luminous bands in the night sky has been carried out since 1921 at Sonneberg. The data disclose periodic variations of intensity of the bands and a certain rhythm in their occurrence. The author has recently succeeded in bringing into relationship with these luminous bands a totally different phenomenon, namely, the disturbances in the ionisation of the upper strata of the atmosphere. These disturbances are best explained by assuming sudden invasions of masses of dust in very high regions of the earth's atmosphere such as occur during the passage of comets. These dust masses may equally be held responsible for the appearance of the luminous bands. It is suggested that periodic variations in the intensity of certain spectral lines may also arise from luminous bands. Reference is made to the possibility of predicting violent disturbances in the ionosphere from the above relationships. H. L. B.

3628. Illumination of the Upper Atmosphere and Twilight Tables. F. Link. *Comptes Rendus,* 199. *pp.* 303–305, *July* 23, 1934.—In the tables of J. Lugeon the effect of the structure of the atmosphere is left out of account. The author shows how the data are modified when the effect of the constitution of the atmosphere is included. Expressions are given indicating the effect of refraction, and also the energy available for illumination of the zenith. This latter is dependent on the wave-length. Photometric measurements give a curve, the slope of which is compared with a corresponding expression derived from the theoretical expressions referred to above. This is independent of wave-length and zenith distance within certain limits stated. The results are in agreement with observations. A. E. M. G.

3629. Noctilucent Clouds. E. H. Vestine. *Roy. Astron. Soc. Canada, J.* 28. *pp.* 249–272, *July–Aug.,* 1934.—The observations and photographs of noctilucent clouds taken at Meanook, Alberta (Lat. 54°37′N., Long. 113°20′W.), on the night of July 20–21, 1933, are given, the observation being possibly the first recorded in America. A method of determining their least possible heights from single station photographs is developed and these heights deduced for the clouds observed at Meanook. A summary of 290 previous observations taken on 187 evenings of the years 1885–1933 is given in brief tabular form. A statistical study of the distribution of evenings of occurrence indicates a close conformity to a normal error law, the maximum frequency appearing about 10 days after the summer solstice, at which time the clouds appear to be most brilliant. The times of yearly preponderance of striking cosmic phenomena, explosive volcanic eruptions and relative sunspots have been compared with the yearly frequencies of noctilucent clouds. The general characteristics of the clouds during the past half century and their probable origin are discussed. AUTHOR.

3630. Glow-Discharge Anemometer. F. C. Lindvall. *Elect. Engineering,* 53. *pp.* 1068–1073, *July,* 1934.—A glow discharge at atmospheric pressure is responsive to air velocity, and may be used as an anemometer. The properties of such a glow are discussed in this paper, and data relating to glow current, voltage, glow length, and air velocity are presented. It is also shown that the glow discharge responds to rapid fluctuations in air velocity and is, therefore, a practical device for investigating turbulence. A comparison of such an anemometer with the hot-wire method previously used is given. AUTHOR.

See also Abstracts 3685, 3710.

SEISMOLOGY.

3631. Pendulum Movement Due to Earthquake Shock. T. Suzuki. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 155–162, *June*, 1934. *In English.*—Expressions are derived for the initial motion of the pendulum when the motion begins with a shock of exponential form, which cannot be expressed in Fourier series [see Abstract 2413 (1934)]. W. A. R.

3632. Vertical Earth Movements and Gravitational Anomalies. N. Miyabe. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 163–173, *June*, 1934. *In English.*—Negative correlation between change of levels in Japan and gravity anomalies indicates that deformation of the earth's crust is in progress mainly to restore isostatic equilibrium. In two districts the correlation is positive, and here it is thought that orogenic or epirogenic movements other than isostatic are predominant. W. A. R.

3633. Relative Seismicity of Different Regions of the World. C. Davison. *Geolog. Mag.* 71. *pp.* 320–323, *July*, 1934.—The relative sesimicity depends partly on the frequency and partly on the intensity of the earthquakes occurring. The data used included Milne's tables of destructive earthquakes in the world from A.D. 9 to 1899 and Cavasino's tables of earthquakes of different intensities in Italy. Values have been computed and are tabulated for the relative seismicity during the nineteenth century and expressed as the average number of earthquakes per 10^6 sq. miles. Results are also given for 40 years in the different Italian provinces. R. S. R.

3634. Piezoelectric Seismographs. A. Herrmann. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 296–301, 1934.—Piezoelectric seismographs possess the advantage of directly measuring the accelerations of the impulses impinging on them. In this article the most suitable modes of cutting quartz and Rochelle-salt crystals for piezoelectric acceleration meters are discussed. With quartz crystals, it is customary to apply the variation of pressure parallel to the electric axis of the crystal. By applying the pressure in the direction of the neutral axis and choosing suitable dimensions the sensitivity of the arrangement can be greatly augmented. Tests were made to ascertain whether any other piezoelectric substance, in particular salt, could be employed. The effect of humidity was studied. The tests showed that Rochelle-salt crystals cut perpendicular to the crystallographic *a* axis were not suitable for acceleration meters, but that such crystals, if cut perpendicular to the *b* axis and inclined at 45° to the *c* axis were very suitable if the surrounding air were kept at a humidity of from 20–25 %. E. L. J.

See also Abstract 3607.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3635. Large-Ion and Small-Ion Content of the Atmosphere at Washington, D.C. G. R. Wait and O. W. Torreson. *Terr. Mag.* 39. *pp.* 111–119, *June*, 1934.—By means of automatic recorders, the small-ion and large-ion content of the atmosphere at Washington, D.C., have been secured. The number of large ions have been continuously recorded over a period of nineteen months and the small ions over a period of twelve months. Curves of diurnal variation of large ions and of small ions for the various months of the year are drawn. During the cold season of the year, the large ions pass through maxima in the morning and in the evening. During the warm season, only the evening maximum is present which shows a seasonal variation in time of occurrence. The small-ion variation through the day is more or less reciprocal to the large-ion variation, but is considerably smaller when regarded on a percentage basis. The large ions and relative humidity vary directly during the cold season and in an inverse manner during the warm season. [See Abstract 2417 (1934).] AUTHORS.

3636. Magnetic Results of the Wilkes, U.S.A., Exploring Expedition, 1838–1842. C. C. Ennis. *Terr. Mag.* 39. *pp.* 91–101, *June*, 1934.

3637. Theory of Unifilar Horizontal-Intensity Variometer. S. E. Forbush. *Terr. Mag.* 39. *pp.* 135–143, *June*, 1934.—The condition for stable equilibrium of a horizontal-intensity variometer, without control-magnets, is derived from the potential energy of the system. It is then shown that for quite sensitive variometers the equilibrium may, for a properly adjusted instrument, become unstable for subnormal values of horizontal intensity which occur during magnetic storms. The effect of temperature-compensation magnets on stability is treated. The scale-value equation is developed and it is shown that the factor which represents the change of scale-value with ordinate may be obtained directly from the value of the horizontal intensity at the instrument, and the optical lever. The effects of a control-magnet upon the conditions for stable equilibrium and upon the scale-value equation are investigated. The possibility of using a control-magnet to decrease temporarily the sensitivity of the instrument during severe magnetic disturbances is suggested. AUTHOR.

3638. Auroræ and Earth-Currents. W. J. Rooney. *Terr. Mag.* 39. *pp.* 103–109, *June*, 1934.—A comparison of auroral observations and earth-current records from the College Fairbanks Station during the International Polar Year 1932–33, shows considerable agreement between the auroræ and disturbances in the earth-current records. Coefficients of linear correlation from 0·71 to 0·76 were obtained from the records for 80 clear nights. Effects associated with brilliant isolated auroral displays at College are readily detected in the earth-current records at Tucson, Arizona, and in exceptional cases, in records obtained as far south as Huancayo, Peru. Oscillatory disturbances in the earth-current records and moving types of aurora, respectively, seem to show the highest degree of correlation. These results are at variance with comparisons of magnetic and auroral records, which indicate a lack of relationship between the two phenomena. AUTHOR.

See also Abstracts 3692, 3693, 3712.

RADIOACTIVITY.

3639. Nuclear Spin of Radioactive Elements. G. Gamow. *Roy. Soc., Proc.* 146. *pp.* 217–222, *Aug.* 1, 1934.—An examination of the relation between the nuclear spin and radioactive constants is given. As regards α-radiation the existence of intense components indicates that the disintegrating and the product nuclei possess different spins. As regards β-radiation, " permitted transitions " result when the initial and resultant nuclei possess the same nuclear spin. When the normal state of the product nucleus possesses a spin different from that of the original one, but one of its excited states has the same spin, it is to be expected that the observed β-spectra will correspond to a permitted transition leading to the formation of an excited nucleus, and will be accompanied by a strong γ-line or several less strong γ-lines if different radiative transitions are possible. Experiments which lend some confirmation of this view are mentioned. These considerations are applied to the forking regions of the three radioactive families, Th, Ra and Ac. J. E. R. C.

3640. Origin of the Actinium Series. H. J. Walke. *Phil. Mag.* *pp.* 256–262, Aug., 1934.—Using the nuclear scheme adopted in a previous paper [see Abstract 2256 (1934)], it is shown that if UZ is a branch product of UX_1, it should be physically identical with UX_2, which it is not. Evidence is given to show that UZ and UY are members of the Ac series and that this arises as the result of the disintegration of a heavy U isotope (protactino-uranium) of mass 239 and not, as was previously supposed, as the result of some branching of the main U series. H. M. B.

3641. Radioactivity of Samarium. M. Herszfinkiel and A. Wroncberg. *Comptes Rendus*, 199. *pp.* 133–135, *July* 9, 1934.—By means of a large ionisation chamber (59 × 50 × 8 cm.) and Sm_2O_3 spread at the rate of 0·25 mg./cm.^{2} over two zinc plates 50 × 50 cm., standardisation being against U_3O_8 spread at 1 mg./7 cm.^{2}, the free path of α-particles from Sm was determined as 15 cm., while 1 gm. Sm. emits 67 particles per sec. [See Abstract 3460 (1933).] C. A. S.

3642. Radioactivity of Neodymium and Samarium. W. F. Libby. *Phys. Rev.* 46. *pp.* 196–204, *Aug.* 1, 1934.—Descriptions of methods for determining (*a*) absolute activity of an element, (*b*) the penetrating power of its radiation, (*c*) the deflectability in a magnetic field and (*d*) the sign of the charge of the radiation are given. The methods involve the use of Geiger-Müller counters with screen walls. Neodymium emits β-rays of maximum Hρ value 355 and 2·4 mm. of air penetrating power. The half-life is slightly less than $1 \cdot 5 \times 10^{13}$ years. The range of the Sm α-particle has been found to be $1 \cdot 23 \pm 0 \cdot 05$ cm. in air at N.T.P. and its half-life $6 \cdot 3 \times 10^{11}$ years. Gadolinium, praseodymium, tin, iodine and beryllium have been found inactive. They cannot have half-lives less than 10^{14} years if they emit particles of ranges greater than 1 cm. The limit for Be is 10^{15} years. AUTHOR.

3643. Artificial Radioactivity. C. D. Ellis and W. J. Henderson. *Roy. Soc., Proc.* 146. *pp.* 206–216, *Aug.* 1, 1934.—The results of an examination of radio-phosphorus, radio-nitrogen, radio-silicon and radio-fluorine are given. In the case of radio-phosphorus the variation of the yield with the energy of the incident α-particle has been studied and it appears that the excitation probability becomes constant at an energy of about 8×10^6 e.v., a value agreeing with the nuclear potential barrier of Al. It is found that the emission of a proton is about 20 × as probable as the emission of a neutron. The efficiencies with which radio-nitrogen, radio-phosphorus and radio-silicon are formed are compared by finding the total number of active atoms generated by a long exposure to a constant source of α-particles. New measurements for the period of decay are obtained at the same time. Since radio-phosphorus at the moment of formation has an energy of recoil of $1 \cdot 76 \times 10^6$ e.v., it is possible to collect the element by this means and its decay period has been measured. A study of the energy of the positrons emitted by radio-phosphorus indicates a continuous distribution between $H\rho 11{,}000$ and $H\rho 2{,}500$. The relation between range and energy is similar to that for β-rays. The energy distribution curve for the positrons is similar to that for β-rays and it is concluded that the mass of the neutrino is considerably less than that of the electron. J. E. R. C.

3644. Distribution of ThC″ in Thallium Solutions. J. Zirkler. *Zeits. f. Physik*, 89. 7–8. *pp*. 439–442, *June* 16, 1934.—The paper gives the results of an investigation of the distribution of ThC″ in a mixed solution of active thallium nitrate and non-active thallium sulphate and a mixed solution of active thallium sulphate and non-active thallium perchlorate. W. E. P.

3645. Variation of Intensity of Excited Radiation Produced by α-Particles of Different Ranges Passing through Air. E. Kara-Michailova. *Akad. Wiss. Wien, Ber*. 143. 2*a*. 1–2. *pp*. 15–18, 1934.—The blackening of a photographic plate placed behind a quartz plate is observed when the former is subject to the radiation produced by α-particles of different ranges passing through air. Exposures of about 1 hour are given and the intensity-range curve shows a rapid increase in blackening as the range is reduced. The behaviour is similar to the standard ionisation-range curve; a maximum occurs at about 1 cm. range after which the curve falls abruptly. The experiments are being continued using plates of lower sensitivity and different gases. F. C. C.

3646. Bragg Curves for Krypton and Xenon. R. Naidu. *J. de Physique et le Radium*, 5. *pp*. 343–346, *July*, 1934.—The ionisation produced by Po α-particles in pure Kr and pure Xe is compared with that produced in air and He. The following figures are given: (1) range at 15° C. and 760 mm. of mercury, $R_{Kr} = 3 \cdot 03 \pm 0 \cdot 01$ cm., $R_{Xe} - 2 \cdot 17 \pm 0 \cdot 01$ cm.; (2) stopping power relative to air, $S_{Kr} — 1 \cdot 227$, $S_{Xe} = 1 \cdot 785$; (3) total ionisation relative to He, $T_{Kr} = 1 \cdot 263$, $T_{Xe} = 1 \cdot 221$, and $T_{air} = 0 \cdot 873$; (4) loss of energy due to effects other than ionisation; Kr 30 %, Xe 40 %, and air 49 %. J. E. R. C.

3647. Dissymmetry of Positive and Negative β-Spectra, and Intrinsic Mass of Neutrino or Ergon. F. Perrin. *Comptes Rendus*, 198. *pp*. 2086–2088, *June* 11, 1934.—The hypothesis that the ergon (neutrino) is of zero intrinsic mass is confirmed by the fact that, on the assumption of the initial equality of momentum of electron and ergon, the dissymmetry of both β^+- and β^--spectra can be deduced mathematically therefrom, the Coulombian interaction of nucleus and electron being negligible [see Abstract 1092 (1934)]. C. A. S.

3648. Natural H-Particles. C. Weiss. *Phys. Zeits.* 35. *pp.* 508–516, *July* 1, 1934.—The ranges of natural H-particles produced by the bombardment of paraffin wax with α-particles are determined with a Geiger counter and an oscillograph. The results are summarised in the following tables :

	α-source	V_{max}	R_{max}	R_{v^3}	R	R_{th}
Table 1.	RaC′	3·071 × 10^9	33·2	28·7	32·5	32·6
	ThC′	3·284 × 10^9	41·6	35·3	40·8	41·3

The columns show, respectively, the maximum velocity of the protons emitted, the maximum range extrapolated from the absorption curve, the maximum range if Darwin's v^3 law were valid, the mean range evaluated from R_{max} and the Blackett-Bethe values for the mean range.

	α-source	R_{min}	$R_{min,\,v^3}$	$R_{min,\,th}$
Table 2	RaC′	22·0	20·3	21·7
	ThC′	29·2	26·0	29·1

Table 2 contains the corresponding quantities for the minimum range. Darwin's formula is seen to fail as the velocities of the protons increase, but Blackett's formula is still valid up to ranges greater than 40 cm.

	α-source	Yield	
		Weiss	Chadwick and Bieler
Table 3.	RaC′	5·0 × 10^{-6}	2·2 × 10^{-6}
	ThC′	8·4 × 10^{-6}	5·1 × 10^{-6}

Table 3 contains the total yield of protons per α-particle between angles of 0° and 8·7° ; the author's values are considerably greater than those of Chadwick and Bieler. F. C. C.

3649. Theory of β-Disintegration. G. Gamow. *Phys. Zeits.* 35. *pp.* 533–542, *July* 1, 1934.—The paper summarises and discusses recent theories of β-disintegration. W. E. P.

3650. Internal Conversion of γ-Rays. J. B. Fisk and H. M. Taylor. *Roy. Soc., Proc.* 146. *pp.* 178–181, *Aug.* 1, 1934.—It is shown that in addition to the fields of radiation which have formerly been assumed, namely, those of electric multipoles, a nucleus may also emit those due to magnetic multipoles, and will in fact emit a combination of both. The internal conversion coefficients arising from such magnetic multipole radiations are calculated, and are shown to be much larger than the corresponding values for electric multipole radiation. It is shown that, on the assumption of a simple model nucleus, the proportion of magnetic radiation actually present is too small to affect appreciably the values of internal conversion coefficients calculated on the assumption of purely electric multipole radiation. A more complete theory of the nucleus is needed to predict the relative amounts of magnetic and electric radiation to be expected from an actual nucleus. In order to bring the theoretical values of the conversion coefficient into agreement with the experimental values for RaB this proportion would need to be of the order of 1 to 50. AUTHORS.

See also Abstracts 3452, 3453, 3454, 3697, 3863, 3948.

RADIATION.

ABSORPTION AND TRANSMISSION.

3651. Spontaneous Change in the Transmission of Light by Thin Silver Films. A. Jagersberger and F. Schmid. *Zeits. f. Physik*, 89. 9–10, *pp.* 557–563, *June* 26, 1934.—In an earlier paper [see Abstract 1970 (1934)] the authors described spontaneous changes in the transmissibility of thin silver films, produced by sputtering, towards visible light. Here the behaviour of such films after having been preserved in a vacuum for some time is described by expressing the change in transmissibility as a function of the film-thickness. It is shown that there is a lower limit to the thickness only for the structural change but not for the change due to the contained gas. The functional relationship allows statements to be made about the structure of thin silver films. [See following Abstract.] H. L. B.

3652. Spontaneous Change in Transmission of Light by Thin Metal Foil. A. Jagersberger. *Zeits. f. Physik*, 89. 9–10. *pp.* 564–581, *June* 26, 1934.—The dispersion equations that hold for metals are applied to thin metal films. The observed change in the transmissibility is calculated from the known spontaneous changes in the resistance. The positive changes in transmissibility in layers whose thickness is less than the lower limiting thickness follow theoretically from the dispersion equations if it is assumed that at a certain thickness the number of free conduction electrons converges to zero, whereas the hypothesis of a decreasing free path gives no positive changes in transmissibility. The amount of gas taken up by the metal film may be calculated in order of magnitude from the optically measured gas effect. [See preceding Abstract.] H. L. B.

See also Abstracts 3496, 3610, 3675, 3676.

COLORIMETRY.

3653. Fading of Coloured Papers. H. Kanazawa. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 209–215, *June*, 1934. *In German.*—Seven strips of differently coloured papers were mounted side by side and coloured Wratten filters were placed over them so that each filter covered a portion of each strip. Seven different filters were used. The whole was then exposed in a south window to direct sunlight and the colours of the papers were measured before and after a 2-year exposure. It was found that red light produced very little bleaching but that white light from which the ultra-violet had been removed produced a strong bleaching effect. The permanence was greatest in the case of the blue and green pigments and was least for red, orange and violet. J. W. T. W.

3654. Estimated Brightness of Coloured Surfaces. M. Yazima and H. Kanazawa. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 216–220, *June*, 1934. *In German.*—Sixteen differently coloured papers were placed in order of brightness by 17 different observers. The agreement between the observers was found to be very good. An order was then established by means of a wedge photometer without colour filters, and a third order by using the Ostwald colour comparator. It was found that all three orders agreed well, but that the agreement was best between those obtained by eye and by the Ostwald method respectively. J. W. T. W.

3655. Specification of Whiteness. D. L. MacAdam. *J.O.S.A.* 24. *pp.* 188–191, *July*, 1934.—Specimens of approximately " white " material having approximately the same dominant wave-length (574 to 576 mμ) but different reflectances (70 to 90 %) and purities (0 to 10 %) were submitted to observers experienced in the grading of white samples, who were asked to arrange the specimens in order of increasing " whiteness." From an analysis of the results obtained, it is concluded that for purities of less than 3 %, brightness (reflectance) chiefly determines " whiteness," whereas for purities greater than 5 %, the purity itself appears to be the main factor. On a graph with reflectance and purity as the axes, contours of equal " whiteness " are drawn to represent the observations made.
W. S. S.

See also Abstract 3684.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3656. Dispersion and Thermal Variation of the Electric Double-Refraction of Optically-Active Liquids. M. Schwob. *Comptes Rendus*, 198. *pp.* 2232–2235, *June* 25, 1934.—The Kerr effect is measured for the dextro-rotatory liquids ethyl tartrate and butyl tartrate. The stroboscopic method of Lucas is used, in conjunction with a formula given by Mallemann, for the wave-lengths 5780, 5460 and 4358 Å. Simultaneously, measurements are made on the dielectric constant, refractive index and density. These values are inserted in the Langevin formula for a non-polar body ; it is shown that the Langevin law only appears to hold over the range 4→15° C. The abnormality in refraction for various temperature ranges is shown. H. J. H. S.

3657. Thermal Variation of Magnetic Birefringence of Mixtures. Mixture with Critical Point. A. Goldet and A. Piekara. *Comptes Rendus*, 199. *pp.* 271–273, *July* 23, 1934.—The magnetic birefringence for λ 5780 and temperatures 10–40°, and the relative variation [measured as $(\beta_{15}-\beta_{25})/10\beta_{20}$, where β_{15} is the measured angle at 15°], have been determined for mixtures of $PhNO_2$ (10–100 %) with CCl_4 and C_6H_{14}, with special attention to mixtures of $PhNO_2$ and C_6H_{14} in the neighbourhood of critical miscibility [51·2 % (wt.) $PhNO_2$ at 15·5°]. The results indicate that the observed variations are due to gradual dissociation, due to dilution and/or heat, of molecular associations of $PhNO_2$, either because such associations orient themselves better by reason of their size, or because such an association is more anisotropic than the isolated molecules. [See Abstract 1098 (1934).] C. A. S.

3658. Magnetic Double Refraction in Liquids. H. A. Boorse. *Phys. Rev.* 46. *pp.* 187–195, *Aug.* 1, 1934.—An apparatus for measuring magnetic double refraction (Cotton-Mouton effect) in liquids is described. The chief feature of the apparatus is a very sensitive variable order compensator, which is discussed in detail. Measurements made with this instrument indicate that path differences as small as $3\times10^{-5}\lambda$ can be determined with a precision of about 12 % provided use is made of very intense light having a wave-length lying within the region which corresponds to maximum visual response. The Cotton-Mouton constants of water and several organic liquids of the aliphatic series including four normal alcohols and five normal acetates are reported and compared with the previous determinations made by other investigators. Certain discrepancies are noted and discussed. AUTHOR.

3659. Kerr Effect and Molecular Structure. H. A. Stuart. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 478–483; *Disc.*, 483, *July*, 1934.—A general account of the application of measurements of the Kerr effect to the elucidation of problems of molecular structure is given. This is illustrated by a discussion of the forms of the molecules of SO_2, ethers and ketones, and by reference to other structural problems. C. B. A.

3660. Mixture-Rule and the Faraday Rotation of Cerium Nitrate. B. N. Chuckerbutti. *Indian. Journ. Phys.* 8. *pp.* 387–395, *April*, 1934.—The Schönrock mixture rule [see Abstract 563 (1933)] has been applied to the case of dilute solutions of cerium nitrate. It is found that the rule does not hold. AUTHOR.

See also Abstracts **3490, 3667, 3937.**

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3661. Influence of Viscosity on Fluorescent Power. J. Bouchard. *Comptes Rendus*, 199. *pp.* 43–45, *July* 2, 1934.—When the viscosity of the solvent is increased to the same extent by addition of glucose, saccharose or glycerin, the fluorescent power is diminished by the same amount. W. R. A.

3662. Afterglow of Active Nitrogen. G. Cario. *Zeits. f. Physik*, 89. 9–10. *pp.* 523–536, *June* 26, 1934.—Previous work is discussed. The various processes which might be responsible for the production of the afterglow are considered. Active nitrogen is atomic and recombination to molecules is possible only as a result of three-body collisions, and molecules so produced are in an excited, metastable state. Collision between two such metastable molecules gives rise to a metastable ^2P atom and a normal atom or two atoms in the ^2D state. These metastable atoms collide with metastable molecules raising these to higher energy levels from which, after emission of the afterglow, they return to their original state. The rôle of predissociation is also discussed. W. R. A.

See also Abstracts **3743, 3744, 3765.**

INTERFERENCE. DIFFRACTION AND SCATTERING.

3663. Machines for Ruling Diffraction Gratings. W. Stone. *Journ. Sci. Instruments*, 11. *pp.* 241–245, *Aug.*, 1934.—A number of improvements are suggested. A new form of thrust bearing is described, designed to reduce the load per unit area and of such a form that its normal operation tends to improve its accuracy. It is suggested that the use of the precision screw should be restricted to defining the length of step, an auxiliary screw being provided to overcome all frictional resistance to the motion of the plate carriage. Two forms of ratchet wheel are described: one is intended to reduce the effect of imperfect centring of the ratchet wheel on the screw; the other embodies a kind of vernier principle and allows the wheels to be made small and with stronger and much more widely spaced teeth than in the usual form. D. H. F.

3664. Application of the Theory of the Transmitting Echelon to the Explanation of Talbot's and Powell's Bands. O. Darbyshire. *Phys. Soc., Proc.* 46. *pp.* 611–625, *Sept.* 1, 1934.—On the basis of the theory of the transmitting echelon, the formation and the asymmetrical character

of Talbot's bands, which are produced when a plate and aperture are placed in certain positions in the beam of a prism spectroscope, are explained analytically and represented diagrammatically. The effects of variation of aperture-width, plate-thickness and inclination of the echelon to the beam are considered. It is contended, in contradiction to A. W. Porter's conclusion, that perfect blackness of the dark bands is approached as the thickness of the plate increases. The appearance of bands when the plate and aperture are placed in front of the spectroscope slit is discussed. A direct diagrammatic representation is given of the formation of bands as photographed by A. C. G. Beach [see Abstract 2954 (1933)] when prism and echelon dispersions are at right-angles. The fact, reported by N. K. Sethi, that in the case of Powell's bands the asymmetry can be reversed by suitable choice of liquid is accounted for, and the criterion for reversal is shown to be equivalent to that stated by Sethi. [See following Abstract.]
AUTHOR.

3665. Determination by Spectrometer of the Metrical Thickness and Dispersive Power of a Thin Film. O. Darbyshire. *Phys. Soc., Proc.* 46. *pp.* 626–630, *Sept.* 1, 1934.—By counting the numbers of Edser-Butler and Talbot bands produced within the same spectral range by a thin film of glass and a prism spectrometer [see preceding Abstract] the metrical thickness of the film can be determined. The refractive index of the film for light of any standard wave-length can then be calculated from a count of the number of Talbot bands passing the position of the corresponding line in the spectrum as the Talbot echelon is rotated about the vertical edge of the film through an accurately measured angle. Two spectrometers are used in conjunction as a double-table spectrometer, and the other apparatus required is of the usual student-laboratory type. In the case of a film about 0·016 cm. thick the thickness is measured with an error not exceeding 0·00004 cm. and refractive indices are measured with an error not exceeding 0·0013. AUTHOR.

3666. Laue Diagrams with Optical Waves. C. Schaefer and L. Bergmann. *Preuss. Akad. Wiss. Berlin. Ber. No.* 10. *pp.* 152–153, 1934. —By means of three quartz piezoelectric oscillators, vibrating in three perpendicular planes, with a frequency of about 2×10^6, an effect is obtained in a liquid which is analogous to the formation of a space lattice. When a beam of light is passed through the liquid in the direction of one of the sets of waves a "Laue pattern" is obtained. When only one of the oscillators is used and the light is passed through the liquid in the direction of the waves, a pattern consisting of concentric rings is obtained. When two oscillators are used and the light is passed along the direction of one set of waves a pattern corresponding to a cross-lattice is obtained.
J. T.

3667. Light-Scattering by Binary Liquid Mixtures. S. Parthasarathy. *Indian Journ. Phys.* 8. *pp.* 275–313, *April,* 1934.— Part I of the paper presents a molecular theory of the scattering of light by binary liquid mixtures in which account is taken both of the optical anisotropy of the molecules as well as of the anisotropy of the Lorentz polarisation field which effectively diminishes the molecular optical anisotropy. Part II presents the results of the experimental study of 25 binary liquid mixtures made by the author, specially to find the variation of the depolarised (orientation) scattering with the concentration of the mixture; the experimental results are compared with the results of the theory developed in Part I, and a satisfactory agreement is found. Part

III contains a further discussion of the experimental results. Part IV contains a discussion in the light of this work of the available data on magnetic and electric birefringence of binary liquid mixtures. AUTHOR.

3668. Photronic Nephelometer. C. H. Greene. *Am. Chem. Soc., J.* 56. *pp.* 1269–1272, *June*, 1934.—In the apparatus described the opalescence at any stage during the titration of $AgNO_3$ solution with HCl is determined by measurement with a photoelectric cell and galvanometer of the amount of light scattered on passage through the solution. The degree of opalescence increases smoothly with time and the curves are satisfactorily reproducible, but the absolute value of the opalescence in a given suspension cannot easily be reproduced; this difficulty is, however, less marked at the higher HCl concentrations and when a comparatively high concentration of HNO_3 is present. H. F. G.

See also Abstracts 3570, 3590, 3766, 3832.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY.)

3669. Photochemical Decomposition of Silk. M. Harris. *Bureau of Standards, J. of Research,* 13. *pp.* 151–155, *July*, 1934.—The strength of silk cloth decreased and its ammonia nitrogen content increased on exposure to sunlight. Samples of the cloth treated with 0·1 *N* NaOH showed smaller changes and samples treated with 0·1 *N* H_2SO_4 greater changes than the untreated cloth under the same conditions. Similar results were obtained on exposure of samples to north skylight. Samples treated with sodium carbonate solution of 1 % or less in concentration showed the greatest stability. The decrease in breaking strength and increase in ammonia nitrogen content of silk on exposure to light are brought about by atmospheric oxidation in the presence of light. The results of these experiments are in accord with those obtained in the accelerated ageing tests of silk, using the carbon arc lamp as a light source. AUTHOR.

3670. Validity of Law of Mass Action for the Photochemical Reaction $2\ SO_2 + O_2 = SO_3$. M. Trautz and F. Helfrich. *Zeits. f. wiss. Phot.* 33. *pp.* 72–80, *July*, 1934.—An apparatus is described whereby mixtures of SO_2 and O_2, in a layer 2–3 mm. thick, may be treated photochemically with the aid of a mercury low-pressure vapour lamp. The mass action constant is measured under various experimental conditions and is shown to be in agreement with the theoretical value. H. J. H. S.

3671. Deuterium as an Indicator of Mechanism in the Photo-Chemical Decomposition of Ammonia. H. S. Taylor and J. C. Jungers. *J. Chem. Phys.* 2. *pp.* 452–453, *Aug.*, 1934.—By studying the photolysis of ammonia-deuterium mixtures it has been experimentally demonstrated that the reaction $NH_2 + H = NH_3$ is an important feature of the overall photochemical decomposition and provides one reason for the low quantum yield observed in the photochemical process. It has further been shown that the interaction of hydrogen atoms with ammonia molecules is a process of low efficiency at room-temperatures. AUTHOR.

3672. Optimum Detail Reproduction of Photographic Negatives. E. Lau and J. Johannesson. *Phys. Zeits.* 35. *pp.* 505–507, *July* 1, 1934. *From the Reichsanstalt.*—By photographing a continuously variable brightness distribution obtained by a scattering method, and then photometering the developed negative with a registering photometer, it is found that irregularities in the photometer trace are minimal at a particular density, corresponding to the point where statistical fluctuations, due to the grain structure of the emulsion, have least effect. At this density, detail reproduction is most perfect. The method can be used for comparing detail reproduction of different plates developed in various ways. W. S. S.

3673. Shape of the Photographic Density Curve in Relation to the Colour of the Acting Light. A. van Kreveld. *Phot. J.* 74. *pp.* 377–380, *July*, 1934. *Comm. from the Phys. Lab., Utrecht.*—The density curve of a photographic emulsion may be defined as the function relating the density to the intensity of the acting light, the exposure time being kept constant. The wave-length of the light influences the shape of the density curve, experimental results obtained showing that this influence is due to four causes—exposure time, absorption and turbidity, dyes, and inherent sensitiveness of the silver bromide grains. The real colour sensitiveness of undyed emulsions and the density curves of mixed colours are also briefly considered, the gradation of mixed colours being given by the addition law. R. C. F.

3674. Theories of Photographic Development. A. J. Rabinowitsch. *Zeits. f. wiss. Phot.* 33. *pp.* 57–71, *July*, 1934.—The process of development consists in the reduction of Ag ions to metallic Ag, simultaneously with the oxidation of the developer. The mechanism of the process has attracted much attention and an account is given of a number of theories which have been put forward to explain it. Three principal experimental methods have been applied to a study of the process, *viz.*, sensitometric, microscopic and physico-chemical methods. Here the account is limited to a discussion of the results obtained from the last method. The following theories are outlined: electrochemical theory, supersaturation theory, catalytic theory and adsorption theory. The authors put forward a new adsorption theory, based on five fundamental principles, which overcomes several difficulties encountered in the older theory. A detailed Bibliography concludes the paper. H. J. H. S.

3675. Red and Infra-Red Transmission of Sensitometric Neutral Filters. R. Mecke, O. Vierling and A. Zobel. *Zeits. f. techn. Physik*, 15. 7. *pp.* 270–273, 1934.—Experimentally determines the variations produced in the values of the absorption factors of a five-step platinum on a quartz filter, a corresponding nine-step silver filter obtained photographically, an Eder-Hecht dye wedge and a Goldberg neutral wedge obtained when the wave-length of the incident light is changed. Three different methods were used to determine the filter factors—a registering photometer using a thermoelement, a photoelectric cell, or a Siemens cell, the Pulfrich step photometer, and the Eder-Hecht sensitometer. The results obtained show that the absorption factor for the platinum filter increases by 20 %–30 % in the red and near infra-red regions, those for the Eder-Hecht and Goldberg filters showing important reductions. R. C. F.

3676. Determination of Filter Factors by the Counter-Wedge Difference Method. E. O. Langer. *Phot. Indust.* 32. *pp.* 818–820, *July* 25, 1934.—Apparatus and methods of measurement are first discussed together with possible errors and means for their removal. Two instruments are then described which embody the above principles and are respectively designed for testing ortho- and pan-chromatic films for portrait and landscape photography on the one hand, and pan-chromatic emulsions for reproduction photography on the other. H. H. Ho.

3677. Inherent Difficulties in the Measurement of Photographic Speed. E. R. Davies. *Brit. Kinematograph Soc., Proc. No.* 17. *Phot. J.* 74. *pp.* 365–376, *July*, 1934.—After a brief description of the basic idea of photographic speed, the work of Hurter and Driffield is dealt with fairly fully under the heads of measurement of light and density, defining correct exposure, origin of H. and D. curves, divergencies between laboratory and practice, question of development variation, derivation of the H. and D. speed number, and achievement and its failings. The assumptions made in the work of Hurter and Driffield fall into two main categories—those that affect the determination of the characteristic curve, and those concerning the interpretation of the curve. All the different assumptions in these two categories are open to question and in some cases liable to complete failure, and the difficulties in determining the H. and D. curve are discussed, points considered being the intermittency effect, failure of the reciprocity law, light quality and colour sensitivity, H. and D. speeds towards light from gas-filled lamps, and speed as affected by development. Finally, the Threshold and the German (D.I.N.) methods of determining speed are dealt with. R. C. F.

3678. Law of the Geometric Mean as a Sensitometric Function. C. C. Lienau. *Frank. Inst., J.* 218. *pp.* 35–39, *July*, 1934.—It is suggested that the generalised law of the geometric mean is a useful empirical formula for describing the behaviour of photographic emulsions. The complexity of its form may be relieved by the use of probability paper and by use of the fact that in the mid-range of densities it reduces to the conventional D—log E relation. A. H.

3679. Nature of the Herschel Effect. O. Bartelt and H. Klug. *Zeits. f. Physik*, 89. 11–12. *pp.* 779–785, *July* 13, 1934.—The spectral distribution of the Herschel effect in pure silver chloride and bromide emulsions is investigated by a photometric method. The curves obtained are in agreement with the measurements of Hilsch and Pohl on the absorption bands of silver halide crystals. It is suggested that the physical origin of the Herschel effect is the transformation of the silver atoms of the latent image to silver ions. H. J. H. S.

3680. Blair-Leighton Equation Applied to the Production of the Latent Photographic Image by Hydrogen Peroxide. M. W. Jones and J. M. Blair. *Frank. Inst., J.* 218. *pp.* 29–34, *July*, 1934.—The Blair-Leighton equation giving the rate of formation of the latent photographic image has already been applied to the production of the latent image by heat [see Abstract 3260 (1934)], and is now applied to the latent image produced by H_2O_2. Eastman 33 plates are employed and these are immersed for varying periods in $0\cdot3\ M$ H_2O_2. After processing they are examined with a densitometer. The results are comparable with those already obtained by Sheppard and Wightman. It is concluded that the process of production of the latent image by different agents (light, heat, H_2O_2) is fundamentally the same. A. H.

3681. Quantum Theory of the Latent Photographic Image. T. H. James and J. J. Coleman. *J. Phys. Chem.* 2. *pp.* 483–487, *Aug.*, 1934.—A general formulation involving quantum ideas is given for the relation between the amount of photolytic action in latent image formation and the amount of light producing it. A method of deducing the number of " effective" quanta per grain necessary to produce developability is given. Slow process emulsions require, in general, the absorption of from 3 to 4 " effective " quanta. This number agrees with that found for physical development by Reinders and Hamburger [see Abstract 2372 (1933)]. Faster emulsions require a smaller number (1 to 2), showing presumably the presence of more highly developed sensitivity centres. The number for any emulsion should depend to some extent upon the developer used. Parametric equations are given which relate the amount of photolytic product to the number of developable grains. These equations lead to a characteristic curve which has a point of inflection when the number of " effective " quanta required per grain is greater than one, but none when the number is equal to one. AUTHORS.

3682. Microphotography in the Infra-Red. H. Naumann. *Zeits. f. Instrumentenk.* 54. *pp.* 236–241, *July,* 1934.—This paper deals with practical methods of overcoming the difficulties of focussing in taking microphotographs in the infra-red using optical systems corrected for use in the visible region. After a mathematical discussion of certain cases, a simple working rule is put forward. This rule, which is found to give satisfactory results with different optical systems, makes it possible to find the correct setting for infra-red work by extrapolation from two observed settings for wave-lengths in the visible. L. A. W.

3683. Distortion of Photographic Emulsions. Part II. Films. G. Berndt. *Zeits. f. Instrumentenk.* 54. *pp.* 228–232, *July,* 1934.—The paper describes measurements on the mechanical strength of films, their resistance to tearing and their extension when subjected to a mechanical load. Tests were made on both roll films and film packs and for different conditions of humidity and, in some cases, of temperature. The results have been tabulated and curves drawn. [Part I see Abstract 609 (1934).] W. D. W.

See also Abstracts 3645, 3690, 3941.

PHOTOMETRY.

3684. Diffuse Reflection and Transmission. H. J. McNicholas. *Bureau of Standards, J. of Research,* 13. *pp.* 211–236, *Aug.,* 1934.—The construction and operation of equipment is described for the study of the diffusion and absorption of light by materials such as textiles, papers, paints, enamels, and other diffusing media for which measurements of colour, gloss, transparency or optical density, hiding and tinting powers or similar properties, are required. Means are provided for the precise control of the directional and spectral distributions of light incident on the sample and for measurement of the corresponding distributions of diffused light. The equipment includes two separate illumination units, one for completely diffused illumination of the sample and the other for uni-directional illumination at any desired angle of incidence. Light reflected or transmitted by the sample under either type of illumination is measured for any desired direction of observation by visual photometric or spectrophotometric methods. AUTHOR.

3685. Application of the Helio-Chromometer. H. Bordier. *Comptes Rendus,* 199. *pp.* 94–95, *July* 2, 1934.—Measurements with the helio-chromometer [see Abstract 2861 (1934)] made throughout the day at Lyons and in Savoy showed in each case a maximum lucimetric index at noon, but differences in the shape of the curve of the index against time of day, pointed to greater transparency of the atmosphere in the former place. Variations of the index with the kinetic state of the atmosphere are noted. W. S. S.

3686. Polar Curve of Flux Distribution. A. Sellerio. *Zeits. f. techn. Physik,* 15. 7. *pp.* 267–269, 1934.—The usual polar curve of candle-power distribution may be converted into a polar curve of flux distribution by multiplying the radius vector at any angle α (from the downward vertical) by $4\pi\sin\alpha$ and taking the square root of the product. This process makes the area of the new curve between any two radii vectors α and β proportional to the flux emitted in the zone α to β. To facilitate the conversion of one curve into the other the author uses an elastic rule graduated in convenient units and capable of being stretched over a wide range of lengths. J. W. T. W.

3687. Light-Technics. M. Pirani. *Die Physik,* 2. 3. *pp.* 127–140, 1934.—The subject of light-technics now includes not only the study of light sources and light distribution, but also physiological and psychological questions bearing on the effectiveness of vision under different conditions. The author gives a brief sketch of the various subdivisions of light-technics, with references to many original papers. The headings are: physiological basis, light-technical measurements, technics of light production (temperature radiators, gas-discharge tubes), illuminating engineering. W. S. S.

See also Abstract 3759.

POLARISATION.

3688. Effect of an Electric Field on the Polarisation of Raman Lines. S. C. Sirkar. *Indian Journ. Phys.* 8. *pp.* 377–385, *April,* 1934.—The effect of an alternating electric field of the order of 15,000 to 25,000 volts per cm. at the peak voltage, on the polarisation of the Raman scattering by some organic liquids was investigated. Some of the lines show an increase in polarisation, some a decrease, while others do not show any change. For example, for the strong Raman line of cyclohexane corresponding to $\Delta\nu = 1028$ cm.$^{-1}$ the depolarisation factor increases by about 16 % of its value, while the well-known 3062 cm.$^{-1}$ line of benzene shows a diminution of the depolarisation factor by about 10 % of its value. AUTHOR.

3689. Dispersion of Polarisation of Raman Lines. S. C. Sirkar. *Indian Journ. Phys.* 8. *pp.* 415–423, *June,* 1934.—The dependence of the polarisation of the Raman lines of some liquids on the frequency of the exciting radiation has been studied. It is found that for such liquids as have their absorption bands in the *near* ultra-violet there is a considerable dispersion in the polarisation. Denoting by ρ the ratio of the intensity of the weak component (vibrating along the direction of the incident light) to that of the strong component, in the transversely scattered light, it is found that for the 1340 cm.$^{-1}$ Raman line of nitrobenzene, the value of ρ for $\lambda 5461$ excitation is only 4/5 of the value of ρ for $\lambda 4358$ excitation. In the case of CS_2, the values of ρ for excitation by $\lambda\lambda 5461$, 4358 and 4046 lines are in the ratios 1 : 0·85 : 0·75. On the other hand for liquids whose absorption bands are farther in the ultra-violet, ρ is found to be practically independent of the frequency of the exciting line. AUTHOR.

3690. Influence of Circularly Polarised Light on the Velocity of Mutarotation of Sugars. P. Souty. *Comptes Rendus,* 199. *pp.* 198–199, *July* 16, 1934.—A sugar capable of mutarotation is quickly dissolved and the solution divided between two tubes, polarimetrically identical and exposed to two circularly polarised beams of light emanating from the

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same source, one dextro- and the other lævo-rotatory. These tubes which are juxtaposed and under identical conditions of illumination and temperature are periodically taken to a polarimeter and their rotations compared. The deviation of the rotations between the two exposed tubes passes through a maximum and disappears when the reaction attains equilibrium. In the case of the Hg green line it exceeds 0°. 25′. An inversion of the direction of the active circular vibrations inverts the effect. The effects of different conditions are given. R. L.

3691. Eyepiece for Measuring Plane-Polarisation of Light. F. E. Wright. *J.O.S.A.* 24. *pp.* 206–216, *Aug.,* 1934.—With this eyepiece the plane-polarisation in a beam of light is compensated by means of a thin, plane-parallel plate of celluloid tilted at the proper angle. To ascertain if the compensation is complete a detector consisting of a quartz plate and a second tiltable plate of celluloid is used in combination with a Savart plate and a nicol or Wollaston prism. The amount of plane-polarisation can be determined, for low percentages, to 0·2 %. The eyepiece has been used chiefly in the measurement of the percentage plane-polarisation in light reflected by different parts of the moon's surface and by terrestrial materials; also for the measurement of sky polarisation and in metallographic work. AUTHOR.

See also Abstracts 3490, 3713, 3714.

RADIATION, EMISSION.

3692. Electrical Constants of the Earth's Surface at Wave-Lengths of 1·5 and 0·46m. J. S. McPetrie. *Phys. Soc., Proc.* 46. *pp.* 637–648, *Sept.* 1, 1934.—A description is given of experiments made to determine the reflection coefficient and the electrical constants of samples of the earth's surface for radiation having wave-lengths of 1·5 and 0·46 m. It is shown that the most sensitive condition for finding the electrical constants of a substance from a study of its reflecting properties for electromagnetic waves is obtained when the radiation is incident normally on the reflector. The experiments described show that in this case the reflection coefficient of copper gauze is practically unity at both wave-lengths. There appears to be little difference in the reflecting properties of ordinary soil and soil covered by grass. It is suggested that the reason for this result may be that in both cases the bulk of the reflection takes place at a small distance below the surface. For radiation having a wave-length of 1·5 m. the dielectric constant of the soil lies between 7 and 16 and the conductivity below about 10×10^8 e.s.u. This upper limit to the value of the conductivity is lower than that, 95×10^8 e.s.u., found previously on the same site at a wave-length of 1·6 m. Part of this discrepancy may be accounted for by the dryness of the season during which the present experiments were made. The results at a wave-length of 0·46 m. indicate possible values of between 7 and 20 for the dielectric constant and up to 40×10^8 e.s.u. for the conductivity of the soil. [See following Abstract]. AUTHOR.

3693. Electrical Constants of the Soil by Lecher-Wire Method at a Wave-Length of 1·5 m. R. L. Smith-Rose and J. S. McPetrie. *Phys. Soc., Proc.* 46. *pp.* 649–658, *Sept.* 1, 1934.—The paper describes an investigation carried out by means of a laboratory method of measuring the electrical properties of the soil with a.c. of a frequency corresponding to a wave-length of 1·5 m. A parallel Lecher-wire system was set up and coupled to a source of oscillations of the desired frequency. The length of the stationary waves set up on the wires in air was measured and compared with the corresponding wave-length when the wires were immersed in the sample of soil under examination. The ratio of these wave-lengths gives directly a quantity involving both the conductivity and the dielectric constant of the soil. This quantity was measured for typical samples of Teddington soil having a wide range of moisture contents, and from the results deductions are made as to the values of the conductivity and dielectric constant of the soil for various moisture-content conditions. Thus for conditions of normal moisture content the dielectric constant is found to have a value of 10 or 12, while the conductivity lies within the range 10 to 28 × 10^8 e.s.u. These values are in good agreement with those obtained by the use of a field method on the same site and at the same wave-length, and their accuracy is adequate for most purposes in connection with radio communication. [See preceding Abstract.] AUTHORS.

3694. Tidal Effect in Kennelly-Heaviside Layer and Correlation of Radio-Reception with Positions of the Moon. H. T. Stetson and J. J. Johnson. *Terr. Mag.* 39. *pp.* 145–158, *June*, 1934.—The paper first reviews characteristics of the ionosphere relating to propagation of radio waves. The mass tidal effect in the atmosphere has been shown by barometer analysis to be at most 1/400 %. Nevertheless, measurements in Norway of the heights of the bases of auroræ show a 6 % movement. At lower latitudes a variation up to 25 % in the height of the conducting layer is surmised; this is supported by magnetic observations in the tropics. Using index cards, corresponding values of the equilibrium height of the lunar tide, and of received radio signal-strength, brought together and arranged in groups, indicate a definite relationship, explicable in terms of the rise and fall of the ionised layers with the tidal force. Correlation of signal-strengths with hour-angle and declination of the moon again yields marked correspondence between radio intensity and equilibrium-tide. This includes the effects that would be expected from the decreasing height of the Kennelly-Heaviside layer toward the poles. In explanation the authors suggest that the moon itself may be a source of ionisation or that the motions of ionic clouds may exhibit resonance with the cyclic tidal force. R. M.

3695. Fluctuations of Cosmic-Ray Ionisation. J. W. Broxon. *Terr. Mag.* 39. *pp.* 121–125, *June*, 1934.—Measurement is made by a null method of the ionisation produced by cosmic radiation in a 13·8-litre chamber containing air at a pressure of 157·5 atmospheres at 17·4° C. The chamber is surrounded by a water shield nearly 6 ft. thick in the basement of a stone building at Boulder, Colorado, altitude 5400 ft., latitude 40° N. Observations were made at 4-hour intervals for 15 consectuive days, April 6–20, 1934, each observation consisting of three 8⅓-minute readings made during a period of one hour. Records of the atmospheric pressure, the relative humidity and the temperature of the out-door air were taken. No regular diurnal variation of the ionisation is observed either before or after reduction to a common barometric pressure. Cosmic-ray character-values (the product of the average by the difference between the extremes of the six-hourly ionisation values) are compared with known magnetic character-values and a correlation is established. Similar correlation is shewn to exist with the character-values of atmospheric potential gradient and absolute humidity. The results of other workers are collected and discussed. F. C. C.

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3696. Solar-Time Period of Unfiltered Cosmic Radiation. J. Barnóthy and M. Forró. *Zeits. f. Physik,* 89. 7–8. *pp.* 437–438, *June* 16, 1934.—A continuous registration for 22 days with a coincidence apparatus gave a solar-time period of the intensity of the cosmic radiation, with two chief maxima exceeding the limits of error at 7 and 13 hours Central European time. During 528 hours 10,100 coincidences were registered. The 7-hour maximum coincides with the temperature minimum, the 13-hour maximum with the temperature maximum. The course of the intensity curve is in good agreement with the results obtained by Hess and Steinmaurer in the years 1931 and 1932 with an ionisation chamber at Hafelekar. J. J. S.

3697. Cosmic Radiation Produced During Artificial Disintegration of Lithium. A. Eckardt, R. Gebauer and H. R. v. Traubenberg. *Zeits. f. Physik,* 89. 9–10. *pp.* 582–591, *June* 26, 1934.—It has been shown earlier by the authors [see Abstract 1834 (1933)] that when lithium is disintegrated by protons there appears in addition to a soft γ-radiation also a very penetrating radiation which can be detected only by interposing matter between the source of radiation and the counting tube. This penetrating radiation is investigated here and its hardness is determined. It penetrates 180 mm. of lead. The ratio of the counted penetrating quanta to the α-particle scintillations is determined and found to be as 1 : 10 in order of magnitude. Possible explanations of the nature of this penetrating radiation are discussed. H. L. B.

3698. Cosmic Rays Inside the Earth. Part I. J. Clay, J. T. Wiersma and G. N. Graaff. Part II. J. Clay, L. J. L. Dey and H. H. J. Bunschoten. *Physica,* 1. *pp.* 659–664, *June,* 1934. *In English.* —In Part I the intensity of the cosmic rays inside the earth's crust is measured to a depth of 200 m. with a set of four Geiger counters. The intensity decreases to less than 0·0018 of the surface-value. In Part II the intensity to a depth of 260 m. is measured with two ionisation chambers. AUTHORS.

3699. Secondary Cosmic Rays from the Wall of an Ionisation Vessel. J. Clay and P. M. van Alphen. *Physica,* 1. *pp.* 665–666, *June,* 1934. *In English.*—Secondaries of cosmic radiation emitted by iron in argon at 75 atmospheres pressure have a range of 1 cm. The volume ionisation is proportional to the pressure. Incidence radiation and emergence radiation are equal. AUTHORS.

3700. Probability Fluctuations of Fourfold Coincidences in Geiger-Müller Counters, Produced by Cosmic Rays. M. R. van der Loeff. *Physica,* 1. *pp.* 667–672, *June,* 1934. *In English.*—A discussion of the distribution in time of the counter pulses due to cosmic rays shows that they are largely distributed at random. AUTHOR.

3701. Magnetic Latitude and Magnetic Longitude Effect of Cosmic Rays. J. Clay, P. M. van Alphen and C. G. 'T Hooft. *Physica,* 1. *pp.* 829–838, *July,* 1934. *In English.*—Three different methods for continuously recording cosmic radiation are described. The third has an accuracy, such that the mean difference over 24 hours from the mean value was 0·18 % at the equator and 0·50 % at 50° latitude. The results are given for two routes on the northern and two over the southern hemisphere with different shielding, and from them a " longitude effect " was found which is caused by the eccentricity of the earth's magnetism. The differences of the ionisation values at different locations on the earth can be explained qualitatively and quantitatively as far as the magnetic features of the earth are known. AUTHORS.

3702. Absorption Phenomena of Corpuscular Cosmic Rays. J. Clay and H. Zanstra. *Physica,* 1. *pp.* 839–848, *July,* 1934. *In English.*—A corpuscular ray may be absorbed (1) with a definite range, or (2) more or less exponentially with an absorption coefficient. The experiments discussed seem to require mechanism (2) with $a = 0{\cdot}3$ per metre of water for primary cosmic rays of energy around 10^{10} V in air, but mechanism (1) for the same rays in lead and for rays of energy around 10^{11} V in water. An interpretation reconciling these results is attempted. AUTHORS.

3703. Mathematical Analysis of Cosmic-Ray Data. L. V. King. *Phys. Rev.* 46. *pp.* 154–156, *Aug.* 1, 1934.—In connection with cosmic-ray calculations, attention is drawn to the existence of extensive tables by Miller and Rosebrugh of the integral $\int_x e^{-u}u^n du$ for integral values of n from -2 to $+2$. Cosmic-ray data may be analysed by a procedure which ultimately depends on Prony's method of analysing a curve into a finite number of exponential constituents. By the use of interpolation theorems and the methods of the calculus of finite differences, observational data for exponential analysis may be derived free from the uncertainties of graphical differentiation. Methods of calculating the effect of self-scattering by the atmosphere are indicated. The exact calculation of the effect of wall thickness in a spherical ionisation chamber is shown to depend on the functions tabulated by Miller and Rosebrugh. AUTHOR.

See also Abstracts 3645, 3687, 3851.

RADIATION, GENERAL THEORY.

3704. Characteristics of Radiation at Very High Energy Levels. M. Bronstein. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. *pp.* 463–465, *June* 11, 1934. *In German.*—It follows from Dirac's theory of the positron that at each temperature a certain portion of the energy of the radiation in statistical equilibrium must always be materialised in the form of electrons and positrons. Then this theory introduces a new kind of alternating action between the photons: two photons with the energy sum $> 2mc^2$ may be able to be transformed into a pair (electron + positron) under the condition of conservation of energy and impulse. The effects of this may play a considerable part at high temperatures such as exist in the interior of the stars. A mathematical discussion is given. J. J. S.

3705. Annihilation Radiation of the Positron. O. Klemperer. *Cambridge Phil. Soc., Proc.* 30. *pp.* 347–354, *July* 30, 1934.—Boron and carbon activated by diplon and proton bombardment have been used as positron-emitting sources in experiments on the annihilation radiation. By coincidence counting with two Geiger-Müller tubes it has been established that the radiation is emitted in pairs. By the coincidence method of Becker and Bothe it has been shown that the annihilation radiation consists only of " soft " quanta. By ordinary absorption measurements it has been shown that the annihilation radiation is homogeneous with a hardness corresponding $0{\cdot}5$ million *e*-volt. AUTHOR.

3706. New Knowledge about Radiation. P. Scherrer. *Assoc. Suisse Élect., Bull.* 25. *pp.* 405–412, *July* 20, 1934.—Sketches the evidence for the wave and corpuscular characters of light and matter and describes the five fundamental particles, photons, electrons, positrons, protons and neutrons. Typical experiments are described showing the way in which transformations occur between these particles, subject to the laws of conservation of energy, momentum and charge. W. S. S.

See also Abstracts 3534, 3895, 3900.

RADIATION, MECHANICAL EFFECTS.

3707. Pressure of Radiation. G. F. Hull, Mary Bell and S. E. Green. *Phys. Soc., Proc.* 46. *pp.* 589–603, *Sept.* 1, 1934.—After a brief account of some early experiments on radiation pressure, Hull reconsiders some aspects of his work, in view of the errors of calculation pointed out by Mary Bell and S. E. Green [see Abstract 2389 (1933)]. A reply follows by the latter authors. AUTHORS.

REFLECTION. REFRACTION AND DISPERSION.

3708. Use of a Plane Mirror in Focimetry. T. Kousmine and L. Meylan. *Helv. Phys. Acta,* 7. 5. *pp.* 520–523, 1934. *In French.*—An account is given of a method of locating the position of a virtual image by making it coincide with the image of an auxiliary object formed by a plane mirror, the criterion of coincidence being absence of parallax. It is pointed out that the mirror used must be accurately plane. A method is described for the direct observation of the principal planes of a thick system and for the determination of their positions. L. A. W.

3709. Refractive Indices of Crystals. A. Cavinato. *Accad. Lincei, Atti,* 19. *pp.* 640–645, *May* 6, 1934.—The author mathematically discusses methods for obtaining the three principal refractive indices by the use of a prism, points out sources of error, calculates the amounts of the errors, and indicates conditions to be avoided. A. D.

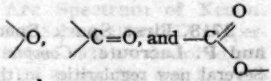
3710. Variations in Refractive Index of CO_2-Free Dry Air and a Statistical Correlation with Solar Activity. L. W. Tilton. *Bureau of Standards, J. of Research,* 13. *pp.* 111–124, *July,* 1934.—All refractive-index data taken on air since 1857 have been examined for evidences of systematic variations and a correlation between refractivity and annual sunspot number has been found, the Pearson r being $-0{\cdot}48$ ($\pm 0{\cdot}08$ probable error) as determined from 40 pairs of values. It seems possible that a decrease in the average rate of stirring and mixing of the air, such as occurs during times of low sunspot numbers, allows certain denser components (perhaps associated molecules or isotopes) to settle and produce at the earth's surface a gaseous mixture having a slightly higher index of refraction. In addition to simple sunspot periodicity of 11 years, however, a superimposed 23-year periodicity, corresponding to a magnetic cycle of sunspots, also seems indicated. Although the value $\mu = 1{\cdot}0002925$ at 0° C. and 760 mm. pressure is a fair general average for the sodium lines index of air, it appears unsafe to rely implicitly on the constancy of μ over a period of years. It may be preferable to make estimates from the equation $(\mu_D - 1) \times 10^7 = 2932{\cdot}2 - 0{\cdot}15$ S, where S is the relative annual sunspot number, and the constants are provisional values derived from all available data. Further experiments should precede the adoption of any radiation in air as a standard of length. AUTHOR.

3711. Refractive Index and Dispersion of Normal and Heavy Water. L. W. Tilton and J. K. Taylor. *Bureau of Standards, J. of Research* 13. *pp.* 207–209, *Aug.*, 1934.—Certain provisional values of the refractive index of normal water are given to accompany similar values determined at 25° C. by the minimum-deviation method for a sample of heavy water (sp.gr.$=1\cdot001376$ at 25° C.) using several wave-lengths of the visible spectrum. According to the linear or additive relation for simple mixtures, which was found adequate in Luten's investigation, the differences in index between H_2O and $H^2{}_2O$ are calculated and compared with previously published values. AUTHORS.

3712. Refractive Index of an Ionised Medium. C. G. Darwin. *Roy. Soc., Proc.* 146. *pp.* 17–46, *Aug.* 1, 1934.—A review of experimental information leads to the result that for a medium containing free electrons the refractive index may very plausibly satisfy either of two formulæ, but it appears correct that with free electrons the Sellmeier type formula $S=\mu^2-1$ applies, while for neutral atoms the Lorentz type formula $L=3(\mu^2-1)/(\mu^2+2)$ applies. A method is developed free from most earlier difficulties and not calling for an analysis of the internal fields in which the refractive index is derived from the electric moment of a small sphere of the medium, the size of the sphere being such that the wave retardation is negligible. The machinery of Hamiltonian dynamics is used to formulate the electric moment of the sphere and the results become manageable. It is confirmed that a gas of electrons neutralised by a continuum of positive electricity will obey the S formula, while a set of self-contained electrons will obey the L formula. Subject to certain prescribed conditions, the contribution to the moment from the collision of an electron with a proton is on the average the same as that from an empty region of the same size and thus fields produced by the protons can be smoothed out and the protons regarded as a continuum. This argument fails if the electrons have not a certain speed and this failure involves all substances obeying the L formula. The conditions for the S formula are fulfilled in the ionosphere and in metals. Mixture of an L and an S medium is considered and the correct rule is to add the S's of the two media together. Finally, the effects of "collision damping" are considered and previous results are confirmed. R. S. R.

3713. Refractive Dispersion of Organic Compounds. Part V. Oxygenated Derivatives of Cyclohexane. Inadequacy of Ketteler-Helmholtz Equation. C. B. Allsopp. *Roy. Soc., Proc.* 146. *pp.* 300–312, *Sept.* 1, 1934.—Values are given for the refractive indices of *cyclo*hexanol at 25° C. and of *cyclo*hexanone and ethyl hexahydrobenzoate at 20° C. at a series of wave-lengths between 6708 Å and 2366 Å. Molecular extinction coefficients for *cyclo*hexanol, *cyclo*hexanone, *iso*butyric acid, and ethyl *iso*butyrate in solution in *cyclo*hexane are also recorded. The curve of refractive dispersion for *cyclo*hexanone contains only a shallow "ripple" in the region covered by the ketonic absorption band (log $\epsilon_{\max}=1\cdot10$ at 2880 Å). The influence of this band on the refractive dispersion is thus remarkably small when compared with the influence on optical rotatory power exerted by the corresponding band in optically active compounds. At wave-lengths remote from an absorption band, the refractive dispersions can each be represented by an equation containing one variable term of the Ketteler-Helmholtz type, with a characteristic frequency corresponding to that of the saturated 6-membered ring of *cyclo*hexane. At wave-lengths covered by or near to the absorption bands, the Ketteler-Helmholtz equation is no longer adequate. The contribution of the ketonic band to the refractive indices of *cyclo*hexanone cannot be represented even approximately by a single term, and evidence is adduced to show that, in the region of absorption, the simple theory of damping breaks down for the refractive dispersion of a liquid just as it has already been shown to do for rotatory dispersion. [For Part IV see Abstract 1150 (1934).] AUTHOR.

3714. Refractive Dispersion of Organic Compounds. Part VI. Refractivities of the Oxygen, Carbonyl and Carboxyl Radicals. Origin of Optical Rotatory Power and of the Anomalous Rotatory Dispersion of Aldehydes and Ketones. T. M. Lowry and C. B. Allsopp. *Roy. Soc., Proc.* 146. *pp.* 313–326, *Sept.* 1, 1934.—From the refractive indices recorded in Part V [see preceding Abstract] values are deduced for the refractivities of the radicals



$>O$, $>C{=}O$, and $-C\overset{O}{\underset{O-}{\lessgtr}}$

over a range of wave-lengths from 6708 to 2400 Å. The refractivity of the carbonyl radical exhibits an anomalous dispersion; that of the oxygen-radical exhibits a slight anomaly, and that of the carboxyl-group is of a normal type, but the values increase very rapidly as the absorption band at about 2075 Å is approached. The anomalous rotatory dispersion of aldehydes and ketones in the region of absorption (which includes two maxima of opposite sign on either side of a zero rotation) cannot be attributed to the anomalous refractive dispersion of the carbonyl-group, since this does not pass through a zero value. This phenomenon might, however, be accounted for by postulating the presence of an additional asymmetric centre *within the chromophoric radical*, as in Lowry and Walker's theory of " induced dissymmetry." AUTHOR.

3715. Refractive Dispersions of Liquid and Gaseous Hydrocarbons. S. Friberg. *Zeits. f. phys. Chem.* 26. *Abt.B.* 3. *pp.* 195–202, 1934.—A comparison is made of the refractive dispersions of liquid and gaseous hydrocarbons. In the methane and ethylene series, the dispersions of gas and liquid between 5800 and 2300 Å are approximately the same. The molecular refractions are additive over the whole spectral range. The method of measuring the dispersions of gases, and the accuracy with which the constants in the dispersion formulæ can be calculated, are discussed. C. B. A.

See also Abstracts 3548, 3570, 3571, 3572, 3573, 3665, 3684, 3691, 3763, 3850.

SPECTROSCOPY.

3716. Spectrum of Zinc. L. and E. Bloch. *J. de Physique et le Radium,* 5. *pp.* 289–298, *July,* 1934.—Spark in air, vacuum spark and electrodeless discharge were used as sources. The first gives diffuse lines and a continuous background; the second gives the spectrum of Zn IV with more than 120 lines between 4000 and 2500 Å, while the third separates the spark spectra of different orders. A list of 800 lines is given of which the majority belong to Zn III. In another table are 50 lines of Zn II which appear to be new. F. S.

3717. S II and S III Spectra in the Region 3300–4900 Å. A. Hunter. *Roy. Soc., Phil. Trans.* 233. 727*A.* *pp.* 303–326, *July* 18, 1934. —The spectra S II and S III have been photographed in the first and third orders of a 10-ft. concave grating spectrograph from λ 3300 to λ 4900 Å. The source of radiation was a condensed discharge through a stream of low-pressure hydrogen containing adjustable amounts of sulphur vapour, the spectra due to the atom in different stages of ionisation being distinguished from one another by suitably altering the experimental conditions. A table given includes many new lines, and particular care has been taken to avoid listing impurities. The great majority of the lines measured are expressed to either 0·01 Å or 0·001 Å, the probable errors being respectively ± ·007 Å and ± ·002 Å. Although the main object of the investigation was to establish accurate wave-lengths for astrophysical application, the comprehensive nature of the results has enabled many new classifications to be made, whilst the increased precision attained has rendered necessary several reassignments amongst lines already classified. A table of revised term values for both ions is therefore included. Of the intense lines in the region investigated only three now await classification. AUTHOR.

3718. First Spark Spectrum of Bromine. L. and E. Bloch and P. Lacroute. *Comptes Rendus*, 199. *pp*. 41–43, *July* 2, 1934.—Several new regularities in the spectrum of Br II have been found by Zeeman-effect methods. The values of 45 terms of the A and B families of this spectrum are tabulated and from these it is possible to classify about 170 lines. W. R. A.

3719. Intensity Distribution and Breadth of Predissociation Lines of the Al-H Molecule. L. Farkas and S. Levy. *Zeits. f. Physik*, 89. 3–4. *pp*. 256–258, *May* 24, 1934.—Supplementary data on previous paper [see Abstract 4504 (1933)] in answer to the criticism of Burger and van Cittert [see Abstract 1591 (1934)]. W. R. A.

3720. Absolute Intensity of the Zinc Resonance Line 3076 Å and the Life of the 2^3P_1 State of Zinc. W. Billeter. *Helv. Phys. Acta*, 7. 5. *pp*. 505–513, 1934. *In German*.—From measurements of the absorption of the zinc resonance line 3076 Å by zinc vapour at different pressures a calculation is made of the absolute intensity of this line and the life of the 2^3P_1 state. The latter is found to have the relatively large value $2{\cdot}6_4\ 10^{-5}$ sec. L. A. W.

3721. Isotopic Displacement Effect for the Zinc Resonance Line 3076 Å. W. Billeter. *Helv. Phys. Acta*, 7. 5. *pp*. 524–536, 1934. *In German*.—This paper contains further deductions from the results of a recently published investigation of the hyperfine structure of the zinc resonance line 3076 Å by the absorption method [see Abstract 2893 (1934)]. It is found that the line has a breadth 1·39 times the theoretical Doppler breadth, although pressure broadening is excluded. This discrepancy leads to the assumption of an isotopic displacement effect. The value of this comes out to $1{\cdot}7_5 \times 10^{-3}$ Å between the isotopes 64 and 66 and $3{\cdot}5 \times 10^{-3}$ Å between the isotopes 64 and 68. On this assumption the form of the resonance curve deduced from the experimental results is in good agreement with the theoretical. L. A. W.

3722. Nuclear Spin of Deuterium. G. M. Murphy and Helen Johnston. *Phys. Rev*. 45. *pp*. 95–98, *July* 15, 1934.—By the methods of photographic photometry, the alternating intensities in emission of the $\Delta v = 0$ sequence of the Fulcher bands of deuterium have been investigated in order to determine the nuclear spin. The alternation of intensities was determined for the P, Q and R branches of each of the 5 bands studied. The average value of g_s/g_a obtained from 4 plates is 1·97 ± 0·03. This value agrees best with the theoretical ratio of 2 and a consequent nuclear spin of 1. Since the even rotational levels are more intense than the odd levels, the nucleus obeys Bose-Einstein statistics. AUTHORS.

3723. Nuclear Spins and Magnetic Moments of the Isotopes of Antimony. S. Tolansky. *Roy. Soc., Proc.* 146. *pp.* 182–199, *Aug.* 1, 1934.—The spark spectrum of antimony has been excited in a hollow kathode discharge and examined for fine structure in the region λλ 6800–5000 with a silvered Fabry-Perot interferometer. Structures, most of which are highly complex, were measured in 26 lines. The structures are completely explained by attributing a nuclear spin of 5/2 to both of the isotopes 121 and 123, but the nuclear magnetic moment of the former is 1·37 times as great as that of the latter. Fine structure interval factors, for both isotopes, have been calculated for 11 terms. The *g* (I) factors are found to be 1·1 and 0·8 for the 121 and 123 isotopes respectively.

AUTHOR.

3724. Hyperfine Structure in the Arc Spectrum of Xenon. E. G. Jones. *Phys. Soc., Proc.* 46. *pp.* 634–636, *Sept.* 1, 1934.—The hyperfine structures of the Xe-I lines λλ 9045, 9799 and 9923 are described and analysed, and the hyperfine separations of the terms $2p_9$ and $2p_{10}$ are derived. It is also found that the lines $1s_5 - 2p$ are readily self-reversed. Previous nuclear spin data are confirmed. AUTHOR.

3725. Deepest Terms in Ions of the Isoelectronic Sequences Ni I to Kr IX and Pd I to Xe IX. P. G. Kruger and W. E. Shoupp. *Phys. Rev.* 46. *pp.* 124–129, *July* 15, 1934.—Radiations corresponding to the energy differences between the terms $3d^{10}\,{}^1S_0$ and $3d^9\,4p\,{}^3P_1{}^0, {}^1P_1{}^0\,{}^3D_1{}^\circ$ in Ge V, As VI, Se VII and Br VIII have been found. Also, the corresponding radiations, $4d^{10}\,{}^1S_0 - 4d^9\,5p\,{}^3P_1{}^0, {}^1P_1{}^0, {}^3D_1{}^0$ in Sb VI, Te VII and I VIII have been observed. A new relation involving displaced frequencies has been used to predict the wave-length of the lines observed and the corresponding lines of Kr IX and Xe IX as yet not observed. A study of the ionisation potentials in the sequences shows that it is possible to calculate the ionisation potentials of atoms more highly ionised than those reported.

AUTHORS.

3726. Electron Configurations p^2s, p^4s. R. Schlapp. *Roy. Soc. Edinburgh, Proc.* 54. 2. *pp.* 109–114, 1933–1934.—The secular equations for the energy levels of the configurations p^2s, p^4s, inclusive of the orbit-spin interaction, are set up using Dirac's result that the electrostatic exchange energy of two electrons is formally equivalent to a magnetic coupling between their spins. The equations are expressed in terms of three parameters, giving respectively the coupling between the equivalent electrons, the coupling between the *s* electron and the core, and the orbit-spin coupling. The Landé *g*-values for the levels are found as functions of these parameters. As an example, the calculated energy levels are compared with those observed in the arc spectrum of arsenic. The agreement is reasonable. AUTHOR.

3727. Photography with Large Dispersion of the Second Harmonic Vibration Band of HCl at 1·19μ. G. Herzberg and J. W. T. Spinks. *Zeits. f. Physik*, 89. 7–8. *pp.* 474–479, *June* 16, 1934.—It is found possible with the aid of new Agfa infra-red plates to photograph the second harmonic vibration band of HCl with the large dispersion of a 3-m. grating. The band lies between 11,800 Å and 12,250 Å. Exact measurement of the band provides improved values for the molecular constants of HCl. It is possible to determine the isotope displacement between HCl^{35} and HCl^{37} with great accuracy, and it is found that the mass defects of the nuclei Cl^{35} and Cl^{37} given by Aston are relatively to one another more accurate than Aston assumes them to be. J. E. K.

3728. Infra-Red Absorption Spectrum of Formaldehyde. Part I. H. N. Nielsen. *Phys. Rev.* 46. *pp.* 117–121, *July* 15, 1934.—The infra-red absorption spectrum of formaldehyde has been further investigated to beyond $11 \cdot 0\mu$ and bands were located at wave-lengths $5 \cdot 7\mu$, $6 \cdot 7\mu$, $7 \cdot 5\mu$, $8 \cdot 6\mu$ and $9 \cdot 6\mu$ in addition to the regions originally reported by Salant and West and Patty and Nielsen near wave-lengths $3 \cdot 5\mu$, $1 \cdot 8\mu$, $1 \cdot 4\mu$ and $1 \cdot 25\mu$. These regions of absorption were all studied under higher resolution and resolved into rotational components. AUTHOR.

3729. Infra-Red Absorption of Solutions of Hydroxides and Hydrolysing Salts. E. K. Plyler and W. Gordy. *J. Chem. Phys.* 2. *pp.* 470–473, *Aug.*, 1934.—Absorption bands have been found at $3 \cdot 65\mu$ and $5 \cdot 2\mu$ in aqueous solutions of NaOH, KOH and LiOH. Solutions of $ZnCl_2$, $ZnBr_2$, $NH_4C_2H_3O_2$, Na_2CO_3, $NaC_2H_3O_2$, $Na_2B_4O_7$, Na_2SiO_3 and $Al_2(SO_4)_3$ were studied in the region from $2 \cdot 8\mu$ to 6μ and bands were observed at about $3 \cdot 45\mu$, $4 \cdot 5\mu$, $5 \cdot 2\mu$ and $5 \cdot 6\mu$. The solutions which are acid in reaction had intense bands at $3 \cdot 6\mu$ and $5 \cdot 2\mu$, while the basic solutions gave a strong band at $5 \cdot 6\mu$. This variation in intensity indicates that the absorption bands are due to undissociated molecules bound to water molecules. The band at $4 \cdot 5\mu$ is probably due to water which has been modified by the ions. The hydroxides showed the absorption bands at $3 \cdot 6\mu$ and $5 \cdot 2\mu$ when $0 \cdot 1N$ solution was used. AUTHORS.

3730. Absorption Spectra in Relation to the Constitution of Keto-Enols. R. A. Morton, A. Hassan and T. C. Calloway. *Chem. Soc., J. pp.* 883–901, *July*, 1934.—On the basis of absorption spectrum measurements, it is concluded that benzoylacetone in dilute solution in hydrocarbon solvents exists almost entirely as $COPh.CH{:}C(OH).CH_3$, and that in other solvents this is in equilibrium with small quantities of diketone. The absorption spectrum of the diketone is the same as that of diketonic methyl-benzoyl-acetone, and resembles that of dimethyl-benzoyl-acetone. The sodium and potassium derivatives have a different structure, and their absorption spectra are also different. The possibilities of chelation are described, and the absorption spectra of keto-enol tautomerism are discussed. The absorbing chromophores are complex, containing one or more simple ones such as $C{=}C$ and $C{=}O$. An attempt is made to attribute the absorption bands of the complex chromophores to the constituent groups. It is concluded that the electronic energy levels associated with the carbonyl and the ethenoid groups are approximately the same. Some Raman data are also recorded. C. B. A.

3731. Absorption Spectra of Nitrotoluidines and Related Substances. R. A. Morton and A. McGookin. *Chem. Soc., J. pp.* 901–911, *July*, 1934.—The electronic mechanism of absorption in benzene, toluene, diphenyl-methane, etc., is essentially the same, and the main absorption band of nitrobenzene, the nitrotoluenes, and the chloronitrotoluenes is also due to the same electronic transition in each case. The introduction of amino- or carboxyl-groups into the benzene ring produces new electron levels. The absorption of the nitrotoluidines is determined by the relative position of the nitro- and the amino-groups, and in acid solution their spectra resemble those of the nitrotoluenes, which are determined by the relative positions of the methyl- and the nitro-groups. Changes in the absorption accompanying change of solvent are investigated. C. B. A.

3732. Chromophoric Groups. Part I.—Ultra-Violet Absorption Spectra of Indene and its Derivatives. Part II.—Absorption Spectra of Naphthalene, Hydronaphthalene and Related Compounds. R. A. Morton and A. J. A. de Gouveia. *Chem. Soc., J. pp.* 911–930, *July*, 1934.—The absorption spectra, in alcohol and in hexane, of hydrindene, indene, benzylidene-indene and cinnamylidene-indene are investigated. That of hydrindene is of the benzenoid type and is presumably due to the same chromophore. The spectrum of indene is similar to that of styrene, and is due to CPh:C. Three regions of absorption are observed in benzylidene-indene, cinnamylidene-indene and crotonylidene-indene, the frequency separation being of the same order as is observed in highly unsaturated compounds such as carotene. An attempt is made to correlate the various absorption bands of all these compounds with the constituent chromophores of the respective molecules. The absorption spectra of naphthalene, Δ^1- and Δ^2-dihydronaphthalenes, tetra-, hexa-, octa-, and decahydronaphthalenes, and of *ac*-tetrahydro-β-naphthol and decahydro-β-naphthol, and of related compounds, are recorded and discussed. C. B. A.

3733. Ultra-Violet Absorption of Binary Mixtures of Organic Liquids. M. Pestemer. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 493–498, *July*, 1934.—The ultra-violet absorption spectra of the systems allyl mustard oil-piperidine (I) and propionaldehyde-ethanol (II) indicate the formation of associated complexes or of compounds. The greatest deviation from additivity in the extinction coefficients occurs in those mixtures whose proportions correspond to compounds. In system I a maximum increase in extinction coefficient is observed, in system II a maximum decrease, the latter being explained by the disappearance of the CO group. Measurements of extinction coefficients for the systems acetone-hexane (III) and acetone-ethanol (IV) are also made. In IV they are additive within experimental error, indicating either absence of complexes or compensation of two inverse influences by the formation of complexes. The latter alternative is supported by the behaviour of system III, where negative deviations from additivity of extinction coefficients occur. C. B. A.

3734. Perturbations in the (9, 8) $^2\Sigma \rightarrow {}^2\Sigma$ N_2^+-Band. H. H. Brons. *Physica*, 1. *pp.* 739–744, *June*, 1934. *In English.*—A rotational analysis of the *P*-branch of the (9,8) $^2\Sigma \rightarrow {}^2\Sigma$ N_2^+-band has been made. The interesting facts in this analysis are the perturbations which occur most probably in the upper state. A general scheme of all the perturbations in the upper Σ-level is given. AUTHOR.

3735. Band Spectrum of CO^+. H. Bulthuis. *Physica*, 1. *pp.* 873–880, *July*, 1934. *In English.*—Of the combination bands $B^2\Sigma \rightarrow A^2\Pi$, (0, 3) and (0, 4), the rotational structure has been analysed. With the aid of these and of the $B^2\Sigma \rightarrow X^2\Sigma$ and the $A^2\Pi \rightarrow X^2\Sigma$ band lines the combination principle was tested. The rotational constants were calculated. Intensity relations in the combination bands are qualitatively in good agreement with the theory for a case between Hund's coupling cases *a* and *b*. AUTHOR.

3736. Spectrum of Gallium Oxide. Marjorie L. Guernsey. *Phys. Rev.* 46. *pp.* 114–116, *July* 15, 1934.—The spectrum of GaO has been photographed with a 21-ft. grating. A band system lying in the region 3800–4200 Å has been identified as a $^2\Sigma \rightarrow {}^2\Sigma$ transition and a vibrational quantum analysis is given. The band heads are approximately located by the equation

$$\nu = \left.\begin{matrix}25{,}706\cdot43\\25{,}709\cdot04\end{matrix}\right\} + 763\cdot63(v'+\tfrac{1}{2}) - 3\cdot89(v'+\tfrac{1}{2})^2 - 767\cdot69(v''+\tfrac{1}{2}) + 6\cdot34(v''+\tfrac{1}{2})^2.$$

The spectrum of indium oxide is briefly discussed. AUTHOR.

3737. Abnormal Rotation of Molecules. O. Oldenberg. *Phys. Rev.* 46. *pp.* 210–215, *Aug.* 1, 1934.—Hypothetical statements, explaining the abnormal rotation of molecules observed in band spectra, are tested by the investigation of the OH bands. It is known that the OH radicals are excited in the electric discharge through water vapour by simultaneous dissociation of H_2O and excitation of OH. As expected, strongly abnormal rotation is observed in the emission spectrum. On the other hand, the absorption spectrum of OH in the electric discharge showing normal rotation, confirms the assumption just mentioned regarding the excitation process. By addition of He the rotation observed in emission is reduced to its normal value ; no appreciable persistence of rotation in collisions is evident. In order to judge whether in a given source the temperature can be derived from the rotational structure of the band spectrum, tentative rules are deduced from a review of the known processes by which abnormal rotation may be produced or destroyed. The intensity distribution of the vibrational structure of a band spectrum indicates the temperature of the gas only in special cases. AUTHOR.

3738. Vibrational Isotope Effects in Three Particle Systems. Part II. A. Adel. *Phys. Rev.* 46. *pp.* 222–225, *Aug.* 1, 1934.—A quantum mechanical analysis of the general potential energy function of the linear, unsymmetrical, triatomic molecule X—Y—Z is developed in terms of the infra-red spectrum of the molecule. The anharmonicity and mutual interactions of the several modes of vibration, as well as the coupling between rotation and vibration are taken into account. It is demonstrated that particular infra-red dàta of two or more molecular isotopes suffice accurately to define the potential function. [For Part I see Abstract 669 (1934).] AUTHOR.

3739. Continuous Emission Spectra of Atomic Origin. G. Balasse. *J. de Physique et le Radium*, 5. *pp.* 304–308, *July*, 1934.—The discharge without electrodes causes the emission of continuous spectra of atomic origin. These continuous spectra were observed for the neutral atoms of the elements K, Rb, Cs, Zn, Hg, P, As, Bi, S, I, and for the ionised atoms of the elements Hg, S, I. These spectra present junctions with the arc lines. These junctions consist in a spreading out in height of the continuous spectrum over the arc line, and are explained by the phenomenon of anomalous dispersion of the vapour in the immediate neighbourhood of the absorption lines of that vapour. J. J. S.

3740. Theory of Temperature Ionisation of Gas. Part I, Quantisation of the Atom. Explanation of the Atomic Continuous Spectrum of Hydrogen. M. Sugita. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 254–264, *July*, 1934. *In English.*—The atomic continuous spectrum of hydrogen, which extends over to the longer wave-length side of the series limit, has been observed in the absorption spectra of stars of types A and B and has also been obtained artificially in emission. The theoretical explanation of this phenomenon is developed as follows. If an atom having a single electron in a certain excited state collides C times per unit time with other particles, the uncertainty of energy value ΔE of this state, which is given by the relation $\Delta EC^{-1} \sim h$, becomes of the order of the difference of the energy values between this level and the next, hence the quantisation of the states breaks down and they become continuous. The number of collisions is obtained from the kinetic theory, and the partial pressure of electrons in the stellar atmosphere is estimated from the number of absorption lines observed in the Balmer series. The effect of the electric field of electrons and ions is also considered. A. H.

3741. Absorption Spectrum of Thallium Fluoride. S. Bolzowa and K. Butkow. *Phys. Zeits. d. Sowetjunion,* 5. 5. *pp.* 765–776, 1934. *In German.*—The absorption spectrum of thallium fluoride vapour was investigated in the region 7000 to 2200 Å. A continuous spectrum, attributed to the molecule Tl_2F_2, was found in saturated vapour at low temperatures. The molecular spectrum of TlF developed at higher temperatures. From the spectrum, the dissociation energy is calculated to be 106 k.cal./mol. The crystal grating energy of TlF is 181 k.cal./mol. F. S.

3742. Absorption and Luminescence of Concentrated Solutions of Colouring Matters. V. Lev̌sin. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. *pp.* 408–411, *June* 1, 1934. *In French.*—Relationships established between absorption and fluorescence of very dilute solutions of colouring matters are no longer observed in concentrated solutions. Increase of concentration of rhodamine 6G from 3×10^{-4} to 3 gm. per l. produces radical changes in the form of the absorption spectrum, but only affects the intensity of the fluorescence which is much reduced. This effect is attributed to the formation of associated molecules which exhibit a different absorption spectrum, but do not fluoresce. Other experimental results confirming this view are given, and the degree of association is calculated from the absorption data. C. B. A.

3743. Dependence of the Contour of the Hg-Line 2537 Å on the Direction of Observation of Resonance Radiation. M. Moraczewska. *Zeits. f. Physik,* 89. 9–10. *pp.* 546–556, *June* 26, 1934.—At room-temperature the width of the Hg resonance line 2537 Å is essentially determined by the Doppler effect. The line contour will thus depend on the direction of observation of the resonance radiation. It is found that on exciting the resonance fluorescence of Hg vapour with the self-reversed line 2537 Å, a self-reversed line is emitted at angle of 15° to the direction of irradiation and a line of Doppler form at an angle of 90° [see Abstract 2444 (1934)]. J. E. K.

3744. Quenching of Mercury Resonance Radiation by Compounds Containing Deuterium. M. G. Evans. *J. Chem. Phys.* 2. *pp.* 445–451, *Aug.,* 1934.—The quenching of mercury resonance radiation by hydrogen, deuterium, ammonia, deutero-ammonia, water vapour and heavy water vapour has been measured. It has been possible to correlate the differences in quenching efficiencies between the heavy and ordinary compounds with the changes in the vibrational level of the molecules which are brought about by the introduction of deuterium atoms. The quenching cross-sections obtained fall on the general type of resonance curve. AUTHOR.

3745. Molecular Spectrum of Cadmium Vapour. S. W. Cram. *Phys. Rev.* 46. *pp.* 205–209, *Aug.* 1, 1934.—The fluorescence and discharge spectra between 1900 Å and 5000 Å of Cd vapour were observed when the vapour was excited under various conditions. The observations include: emission of band spectra between 2212 and 2288 in both spectra, the process of excitation of some of the fluorescence spectrum, and a general summary of the Cd band spectra. Potential energy-nuclear separation curves for the Cd molecular are concluded from these observations and from the results to be presented in another paper. AUTHOR.

3746. Quadratic Zeeman Effect in the Principal Series of Sodium. E. Segrè. *N. Cimento,* 11. *pp.* 304–308, *May,* 1934.—By photographing the absorption spectrum of sodium vapour near the limit of the principal series, with and without a magnetic field, a displacement of the lines was observed corresponding to the term quadratic in the magnetic field strength in the normal Zeeman effect. Although only qualitative, the results are in accord with the theory of the second approximation. W. S. S.

3747. Zeeman Effect in Triplet Bands. R. Schmid. *Zeits. f. Physik,* 89. 11–12. *pp.* 701–707, *July* 13, 1934.—The values available are considered on the basis of Hund's formula. The $^3\Pi \rightarrow {}^3\Pi$ bands of C_2(Swan) and N_2 (2nd positive group) and the $^3\Pi \rightarrow {}^3\Sigma$ bands of NH (near 3660 Å), show only the " regulating " or " simplifying " effect. The 3rd positive CO bands $^3\Pi \rightarrow {}^3\Sigma$ show true splitting of the lines. Branch lines whose end state is a $^3\Pi_1$ term give sharp triplets with twice the normal separation of components. Lines which belong to $^3\Pi_0$ and $^3\Pi_2$ show weakened and broadening splitting. F. S.

3748. Influence of an Electric Field on the Limits of the Potassium Series. E. Amaldi. *Accad. Lincei, Atti.* 19. *pp.* 588–594, *April* 22, 1934.—The absorption series 4S–*n*S and 4S–*n*D have been photographed when polarised in a direction parallel to the applied field and the series 4S–*n*D perpendicular to the field, the light source being an arc in hydrogen and the potassium vapour being maintained at about 800° C.; the applied field was up to 2470 volts per cm. The Stark-Lo Surdo effect is observed to commence at 4S–15P; the calculated and observed effects are given and discussed. [See following Abstract.] H. F. G.

3749. Influence of an Electric Field on the Absorption Series of Sodium. E. Segrè. *Accad. Lincei, Atti,* 19. *pp.* 595–599, *April* 22, 1934.—Experiments similar to those carried out by Amaldi with potassium vapour [see preceding Abstract] are described and discussed. H. F. G.

3750. Anomalous Deviations in the Stark Effect of Hydrogen. W. Steubing and P. Jäkel. *Zeits. f. Physik,* 90. 1–2. *pp.* 112–132, *July* 24, 1934.—It was observed that the anomalous deviations in the Stark effect in hydrogen are neither produced nor influenced by (1) direction and sign of the electric field, (2) discharge conditions and gas pressure, (3) space or boundary charges, (4) foreign gases, electric charge carriers of both signs, or processes of transfer of charge. They appear to be dependent on the previous history of the hydrogen atoms in the canal-ray bundle before its entrance into the electric field, and perhaps of most importance is the diffuse scattering of the atoms at an edge bounding the canal-ray beam. The behaviour of the canal-ray atoms of hydrogen in the Stark effect differs according as they are scattered by the edge partially limiting the canal ray, outwards into the " shadow space " of the edge, or forwards. The atoms scattered into the shadow region show deviation towards the violet, those scattered forwards deviation to the red. There exists occasionally a most favourable angle of scattering after the overstepping of which the deviation again decreases. J. J. S.

3751. Intensity Measurements in the Raman Spectrum of Carbon Dioxide. Isabel Hanson. *Phys. Rev.* 46. *pp.* 122–123, *July* 15, 1934.—A simple photographic method of measuring intensities in the Raman effect was devised. The ratio of the intensities of the strong

Raman doublet of CO_2 was found to be 0·572 instead of 0·667 as roughly estimated by Dickinson, Dillon and Rasetti. This value (0·572) although in apparent disagreement with the calculations of Dennison and Adel [see Abstract 4102 (1933)] is in fair agreement with Placzek's recent work. An exposure of 24 days brought out three lines in addition to the four commonly observed. They may be identified with three of the lines predicted by Dennison and Adel. AUTHOR.

3752. Raman Spectrum of Heavy Water Vapour. D. H. Rank, K. D. Larsen and E. R. Bordner. *J. Chem. Phys.* 2. *pp.* 464–467, *Aug.*, 1934.—The Raman spectrum of heavy water vapour was obtained by using water having a $d^{20}_{20}=1·073$, at two atmospheres pressure. A line $\Delta\nu=2666$ cm.$^{-1}$ was found for D_2O and $\Delta\nu=2718$ cm.$^{-1}$ for HDO. The other line expected from the work of Wood on liquid heavy water in the region $\Delta\nu=3700$ cm.$^{-1}$ was not found. The line $\Delta\nu=3650$ cm.$^{-1}$ of H_2O was resolved into a doublet $\Delta\nu=3646·1$ cm.$^{-1}$ and $\Delta\nu=3653·9$ cm.$^{-1}$. An attempt has been made to explain the Raman spectrum of H_2O empirically by using the data of Mecke on the infra-red absorption spectrum of H_2O. AUTHORS.

3753. Raman Spectrum of Water. M. Magat. *J. de Physique et le Radium*, 5. *pp.* 347–356, *July*, 1934.—The water was distilled twice from $KMnO_4$ and ultra-filtered through collodion into the experimental tube. The Wood method of observation was employed, with a filter of Victoria blue which absorbs all lines except the λ 4358 group of Hg. The following lines were observed (in cm.$^{-1}$) 175, 500, 740, 1659, 2135, 3200, 3400, 4032, 5100. The line observed by other workers at 3630 could not be found, although a special search was made for it. In the course of the work the curious satellite lines accompanying the main lines in the Hg arc were studied, and it is shown that regarded as " shifts " from the main lines, they have the same values, whatever the value of the main line. Three bands are ascribed to vibrations between atoms in the H_2O molecule. Many other bands are then shown to be harmonics or combinations of three. Six bands still remain ; these are attributed to vibrations between molecules forming larger complexes, and intercombinations between the intermolecular and the interatomic frequencies. A band at 60 cm.$^{-1}$ is attributed to rotation about the axis of figure of the molecule, the only rotation possible. A. C. M.

3754. Raman Effect in Fused Inorganic Nitrates. V. N. Thatte and A. S. Ganesan. *Indian Journ. Phys.* 8. *pp.* 341–344, *April*, 1934.—The lines scattered by the following fused nitrates were observed : Li, Na, K, Ag, Mg, Zn, Cd, Al and Tl. The lines observed in the solid crystal and in solutions in water are compared with those for the fused salts. In general the frequencies for the fused salt are roughly intermediate between those for the solid and the solution. The line at 1050 cm.$^{-1}$ came out with great intensity in all cases. A. C. M.

3755. Raman Spectra of Isomeric Alcohols. G. V. Nevgi and S. K. K. Jatkar. *Indian Journ. Phys.* 8. *pp.* 397–408, *April, and pp.* 409–414, *June*, 1934.—A study of the Raman spectra of isomeric butyl, amyl and octyl alcohols has revealed several distinguishing frequencies in these compounds. An attempt has been made to explain the width of the lines corresponding with long shifts 2870-2930 cm.$^{-1}$ which appear to be due to the several C→H linkages. 1060 cm.$^{-1}$ and 1300 cm.$^{-1}$ are the characteristic frequencies of straight chain alcohols. 840 cm.$^{-1}$ and 1100 cm.$^{-1}$ appear both in primary and secondary alcohols while 1200 cm.$^{-1}$ is only shown in tertiary alcohols. The assignment of shifts 750 to 1030 cm.$^{-1}$ to vibrations of the R→OH linkage has been confirmed by comparing the heats of dissociation calculated from the Raman frequencies with thermal data. The heats of dissociation tend to decrease in a homologous series and more markedly in passing from primary to tertiary alcohols. AUTHORS.

3756. Rotational Raman Effect in Liquids. Part I. Benzene. S. Bhagavantam and A. V. Rao. *Indian Journ. Phys.* 8. *pp.* 437–445, *June*, 1934.—A quantitative investigation is made of the intensity distribution within the unresolved wings accompanying the Rayleigh lines in benzene. Special care is taken in eliminating all the parasitic light and corrections are introduced for the broadening of the pure Rayleigh lines due to over-exposure. In this way the wing has been followed up to a distance of about 6 wave-numbers from the central line. The intensity of the wing starts from being a maximum at or very near the centre and rapidly falls off till a distance of about 20-wave-numbers is reached. Thereafter the intensity gradually falls off but persists till a distance of about 130 wave-numbers is reached. The results are discussed in the light of the existing theories and it is concluded that the entire wing cannot be explained as due merely to the rotation of the benzene molecules. AUTHORS.

3757. Raman Spectrum of Ethyl Alcohol. G. Bolla. *Zeits. f. Physik*, 89. 7–8. *pp.* 513–521, *June* 16, 1934.—The Raman spectrum of ethyl alcohol, excited by Hg 2537 Å, is photographed with a spectrograph having a mean dispersion of 1·7 Å per mm. between 2500 and 2800 Å and a resolving power of about 30,000 at 2700 Å, thus permitting of the separation of lines lying 1·4 cm.$^{-1}$ apart. Microphotometer records of the spectra are reproduced. It is found that the Raman "lines" of ethyl alcohol are in reality bands, practically symmetrical in form and having half-value widths lying between 15 and 45 cm.$^{-1}$. A broad unsymmetrical band, corresponding to the band of water, is observed at about 3360 cm.$^{-1}$ and is ascribed to the OH group. L. A. W.

3758. Raman Spectra and Structure of Metallo-Chloroforms. H. Volkringer, A. Tchakirian and Marie Freymann. *Comptes Rendus*, 199. *pp.* 292–294, *July* 23, 1934.—The Raman spectra of the chloroform analogues $GeHCl_3$ and $SnHCl_3$, investigated in HCl solution, are found each to consist of four lines of relatively low frequency. A comparison is made with the spectra of $CHCl_3$ and $SiHCl_3$, and the absence of a line of higher frequency corresponding to 3018 cm.$^{-1}$ of $CHCl_3$ and to 2258 cm.$^{-1}$ of $SiHCl_3$ is explained as due to ionisation of the hydrogen in the cases investigated. L. A. W.

3759. Use of Iceland Spar for the Intensity Calibration of Slit Spectra. Y. Öhman. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 24*A*. *No.* 10. *pp.* 1–4, 1934. *In English.*—A crystal of Iceland spar is placed in a spectrograph so as to give two separated spectra of different intensities. The spectrograph itself gives a fairly strong polarisation due to the reflections at the surfaces of the prism or prisms. This instrumental polarisation provides an excellent means of the intensity calibration of plates. The use of Iceland spar crystal is as accurate a method of standardising slit spectra as the grating method is for standardisation of objective prism spectra. J. E. K.

3760. Hydrogen Discharge Tube for Spectrographic Work. H. J. J. Braddick. *Cambridge Phil. Soc., Proc.* 30. *pp.* 355–356, *July* 30, 1934.—A type of hydrogen discharge tube is described which has been used with a power input of up to 4·5 kW. It is claimed that the tube is robust, portable, easy to set up and align. The construction is of pyrex glass, the waxed-on window being of crystalline quartz. A. H.

3761. Quantitative Spectral Analysis of Gas Mixtures. F. Klauer. *Ann. d. Physik*, 20. 2. *pp.* 145–160, *June*, 1934.—Methods of excitation are discussed in relation to their suitability for spectral analysis. The presence of electrodes in the discharge tube is obviously undesirable, whilst the Lilienfeld method, although reasonably sensitive, does not afford satisfactory reproducibility of the intensities of the lines. The h.f. glow discharge is free from this defect and is highly sensitive; it is simply produced by means of a Tesla coil of which the electrodes are connected to metal-foil electrodes placed around the tube. Study of various gas mixtures gave the following limits of sensitivity for the detection of the first-named component: H_2 in He, 0·07 %; He in H_2, 0·8 %; H_2 in A, 0·5 %; A in H_2, 1·0 %; the pressure used varied from 0·1 to 0·4 mm. H. F. G.

3762. Alkali Metals in Natural Waters. R. Bossuet. *Comptes Rendus*, 199. *pp.* 131–133, *July* 9, 1934.—By means of the author's method the presence of Li, Na, K, Rb and Cs is demonstrated in 58 French mineral springs, and that of Li, Na, K and Rb in 26 others, in 17 French rivers, and in sea water. Cs is present in waters derived from primitive rocks, absent from those of superficial origin. [See Abstract 3543 (1933).] C. A. S.

3763. Test of the Principle of Spectroscopic Stability. O. Halpern. and E. Wasser. *Phys. Rev.* 46. *pp.* 177–180, *Aug.* 1, 1934.—The spectroscopic stability required by quantum mechanics is subjected to a direct test, and it is demonstrated that the atoms of saturated Tl vapour exhibit no double refraction due to spatial quantisation in a magnetic field up to 1200 gauss. The accuracy of the measurement permits of the assertion that if present at all the phase-difference between the component of the electric vector at right angles and that parallel to the field, is less than 10^{-5} of the wave-length employed. At the pressures employed this establishes a constancy of atomic refractivity to one part in 10^4. AUTHORS.

See also Abstracts 3663, 3688, 3689, 3713, 3714, 3855, 3857, 3870.

VELOCITY OF LIGHT.

See Abstract 3542.

VISION.

3764. Variation of Pupillary Diameter with Illumination. R. Faillie, R. Jonnard and H. V. de Sachy. *Comptes Rendus*, 199. *pp.* 89–91, *July* 2, 1934.—Measurements of the pupillary diameter were made by flashlight photography, for a subject viewing an opal glass illuminated to various brightnesses (*a*) with white light, (*b*) with yellow light (no blue or violet). The pupillary diameter is plotted against the illumination in the pupillary plane, and the curves tend to constant values at sufficiently high illuminations. The limiting value for yellow light was found, for each of the three subjects studied, to be higher (about 10 %) than for white light. According to Broca's views this would mean that the yellow light produced less visual fatigue than white of the same brightness. W. S. S.

See also Abstract 3655.

X-RAYS.

3765. Emission of a Feebly Penetrating Radiation by Electrified Insulators. G. Reboul. *J. de Physique et le Radium,* 5. *pp.* 329–342, *July,* 1934.—Electrified bodies always discharge slowly even with all precautions because of conduction or by the surrounding gas becoming ionised. The substances examined included resin, paraffin, ebonite, sulphur, and amber. Some anomalies in the behaviour of these substances are first described. Values are then obtained for the rate of loss of the electricity. The variation of the emission with time is examined with regard to the sign and intensity of the field causing the loss of electricity. The absorption coefficient is determined for air and cellophane. Measurements made indicate that the phosphorescence and fluorescence produced is due to a radiation in the extreme ultra-violet or a soft-X-ray with a wave-length between a few tenths and hundredths of an Ångström unit. The effects obtained are supposed to be due to the breakdown of closed groups of atoms and electrons and the radiations observed correspond to certain energy levels in sulphur and carbon. [See Abstracts 3523 (1933) and 3324 (1934).] R. S. R.

3766. Ring System Formed on the Kathode of a Hadding's X-Ray Tube. K. Prosad and S. Sharan. *Indian Journ. Phys.* 8. *pp.* 425–430, *June,* 1934.—The ring system formed on the kathode of a Hadding's X-ray tube has been shown to be due to the interference of light in the thin film of copper (of which the antikathode was made) deposited on the kathode. A method has been suggested for the determination of μ of a thin film of metal with respect to any monochromatic light used to view the ring system. AUTHORS.

3767. Diffuse Scattering of X-Rays from Sodium Fluoride. Using Sensibly Monochromatic Radiation. P. S. Williams. *Phys. Rev.* 46. *pp.* 83–86, *July* 15, 1934.—The Mo K_α lines, together with a small amount of the continuous spectrum of half the wave-length, were isolated by crystal reflection and scattered from a crystal of NaF at room-temperature. Ionisation currents were measured by using an FP-54 pliotron and d.c. amplifier. Comparison was made with the scattering at 90° from paraffin, and S_{class} was determined between $x=0\cdot1$ and $x=1\cdot0$. It agrees fairly well with the S_{class} obtained by the author in a previous research using a band of wave-lengths. Comparison is made between the observed S_{class} and these computed by theory from wave-mechanics atomic structure factors, using the assumptions of zero-point-energy or no zero-point-energy. The discrepancy between experiment and theory, especially if the former assumption is correct, seems considerable enough to imply the need for some modification in the theory, probably in the incoherent scattering term. [See Abstracts 4355 (1932) and 235 (1934).] AUTHOR.

3768. Scattering Values near L-Absorption Edges. J. Brentano and A. Baxter. *Zeits. f. Physik,* 89. 11–12. *pp.* 720–735, *July* 13, 1934.—A paper on careful measurements made in the neighbourhood of the L-absorption edges of W and Tl. A. D.

3769. Mass Absorption Coefficients of Monochromatic X-Rays. K. Grosskurth. *Ann. d. Physik,* 20. 2. *pp.* 197–232, *June,* 1934.—Using a modification of Küstner's method, the mass absorption coefficients of paraffin and of 16 elements ranging from C to Pb, have been measured. Tables and curves of the results are given. The radiations used were the characteristic lines of 38 elements from U (0·1279 Å) to Cr (2·2863 Å).

Considerable care was taken to ensure the purity of the filter materials, and analyses are given in most cases. The experimental errors are considered, the question of oblique filtration being dealt with in some detail. The photoelectric absorption is shown to follow the formula $\tau = C\lambda^n$ fairly closely, and in general it is possible for each element to obtain values of C and *n* for either side of the K absorption edge. By introducing the atomic weight into the more usual formula it is possible to devise a more suitable universal formula for the mass absorption coefficient. The formulæ suggested are $\mu/\rho = 0{\cdot}02836(Z^{3{\cdot}70}/A)\lambda^{2{\cdot}7377}$ for the short-wave side, and $\mu/\rho = 0{\cdot}001266(Z^{4{\cdot}04}/A)\lambda^{2{\cdot}7377}$ for the long-wave side of the K-absorption limit. For the lighter elements, the difference between μ and τ is sufficiently large for the Compton scattering to be estimated. The classical mass-scattering coefficient, σ_0/ρ for paraffin is 0·18, for C 0·16, and for S and Al 0·14. For the heavier elements the value appears to increase to a value somewhat less than 0·7. Measurements of the K-absorption jump for a number of elements give values less than those of the Jönssen theory, the discrepancy increasing for the heavier elements. J. E. R.

3770. Absorption of Monochromatic X-Rays of Short Wave-Length. T. M. Hahn. *Phys. Rev.* 46. *pp.* 149–153, *Aug.* 1, 1934.—With a Société Genevoise double crystal spectrometer, the mass absorption coefficients of eight different elements extending from H (from paraffin and carbon) to Pb were determined for a wave-length of 208·6 X units. An attempt to make a similar series of measurements on the $K\beta_1$ line of W failed because of the low intensity of the X-rays. With the same instrument, but with the first crystal removed as a single crystal spectrometer, measurements were extended down to 138 X units. The atomic absorption coefficients determined from these measurements were found to be given accurately by the equation $(\mu_a/Z) = C_k Z^{3{\cdot}18}\lambda^q + (\sigma/\sigma_0)\sigma_0$, where σ/σ_0 is given by the Klein-Nishina formula rather than the Breit and Dirac or Compton formulæ for scattering. In the case of H however the atomic absorption coefficient (calculated from the difference between measurements on paraffin and carbon) was within experimental error equal to the Thomson scattering for the range of wave-lengths used. The constant q appears to have the value 2·50 for this region, and C_k the value $5{\cdot}81 \times 10^{-7}$, if λ is measured in cm. In general the absorption coefficients agree fairly well with those of other observers except for a slight discrepancy in the case of Cu; a peculiarity is pointed out in the case of Ag. AUTHOR.

3771. X-Ray Dispersion in Nickel by Total-Reflection Method. A. J. Lameris and J. A. Prins. *Physica,* 1. *pp.* 881–888, *July,* 1934. *In English.*—The critical angle of total reflection at nickel is measured for a continuous range of X-ray wave-lengths near the Ni K-absorption edge. The apparatus consists of two crossed systems, a spectrograph system and a mirror system. No discontinuity is found from a smooth dispersion curve. A considerable departure found by Kiessig is traced to the use of a different mirror from that used in the rest of his work. The present curve, however, shows a small systematic departure from theory (Hönl, etc.), for which the authors are unable to account satisfactorily. T. L. M.

3772. Quadripole Lines in the K-Series of Ruthenium. E. Wilhelmy. *Phys. Rev.* 46. *pp.* 130–132, *July* 15, 1934.—The Ru $K\beta_4$ ($K-N_{IV}N_V$) and $K\beta_5$($K-M_{IV}M_V$) lines have been observed with a double crystal spectrometer. The wave-lengths are **559·74** and **566·68** **X units, respectively.** $K\beta_5$ **appears to be a doublet, the weaker component**

lying at the long wave-length side. The doublet separation of 0·15 X unit is within the experimental error in accordance with the $M_{IV}-M_V$ difference. The width of the single components of $K\beta_5$ is smaller than the width of $K\alpha_1$, *i.e.*, <11 volts. $K\beta_4$ is considerably broader, 28 volts. The intensity ratios are $K\beta_4 : K\alpha_1 = 1 : 160$, $K\beta_5 : K\alpha_1 = 1 : 400$. Also a very faint line $K\beta_6$ has been observed the intensity of which is 1 : 2000 of the intensity of $K\alpha_1$. The wave-length of $K\beta_6$ is 558 X units. It cannot be explained by single electron transitions between known Ru levels. AUTHOR.

3773. M-Lines of Br(35) and Rb(37). M. Siegbahn and T. Magnusson. *Arkiv f. Mat., Astron., och Fysik, Stockholm, 24B. No.* 4. *pp.* 1–5, 1934. *In German.* Illustrates and tabulates the M-lines of Br and Rb. A. D.

3774. Higher Series of X-Ray Spectra. M. Siegbahn and T. Magnusson. *Arkiv f. Mat., Astron., och Fysik, Stockholm, 24B. No.* 6. *pp.* 1–5, 1934. *In English.*—Investigation of the N-, O-lines of the heavier elements in the " ultra-soft " region 20–500 Å, by the use of ruled gratings and especially concave gratings. A. D.

3775. O-Series of X-Ray Spectra. M. Siegbahn and T. Magnusson. *Arkiv f. Mat., Astron., och Fysik, Stockholm, 24B. No.* 7. *pp.* 1–2, 1934. *In English.*—Gives experimental evidence for the existence of O lines, *viz.*, one line in the spectrum of Th. A. D.

3776. Emission Lines and Absorption Edges in the L-Series of Ba and Cs. G. Kellström and B. B. Ray. *Arkiv f. Mat., Astron., och Fysik, Stockholm, 24B. No.* 13. *pp.* 1–5, 1934. *In English.*—The extension of the different X-ray series into the domain of the ultra-soft X-ray region and the identification of the lines there found have given a new importance to the values of the outer atomic levels. The only way to obtain more reliable values for the levels is to determine the wave-lengths more accurately. The present paper is a contribution towards this purpose. Tabulated results are given, for Ba and Cs. A. D.

3777. X-Ray Absorption Edges of $GeCl_4$ and $AsCl_3$. D. Coster and G. H. Klamer. *Physica*, 1. *pp.* 889–894, *July*, 1934. *In English.*—The fine structure of the K-absorption edges of germanium and arsenic, respectively present in the vapours $GeCl_4$ and $AsCl_3$, has been determined. In both cases this fine structure is very pronounced and extends to a distance of several hundred volts from the edge. For $GeCl_4$ the fine structure is in agreement with theoretical expectations ; for $AsCl_3$ it may be concluded from the fine structure that the distance of the Cl-atoms from the As-atoms is about 2·20 Å. AUTHORS.

3778. Calculation for the K-Absorption Band of Ge in $GeCl_4$. D. R. Hartree, R. de L. Kronig and H. Petersen. *Physica*, 1. *pp.* 895–924, *July*, 1934. *In English.*—The theory of the fine structure of X-ray absorption bands in molecular gases is applied to the K-absorption of Ge in $GeCl_4$. The atomic wave functions and atomic field of the neutral Cl-atom are computed by the method of the self-consistent field. New procedures for determining the phase angles δ, occurring in the description of electron scattering as given by Faxén and Holtsmark, and required for the interpretation of the fine structure, are developed, and the δ_l of neutral Cl obtained for $l = 0$ to $l = 11$ and for energies of the electrons between 0 and 200 V. The fine structure calculated by means of these δ_l is found to be in satisfactory agreement with the measurements of Coster and Klamer. The advantages and disadvantages of the fine structure analysis as compared with other methods of investigating molecular configurations are briefly discussed. AUTHORS.

3779. L-Absorption Discontinuities of Bismuth. L. H. Carr. *Phys. Rev.* 46. *pp.* 92–95, *July* 15, 1934.—The problem of obtaining a thin enough absorber was solved by using the bismuth in solution. Bismuth nitrate dissolved in dilute nitric acid was held in one cell, while in another like cell was put only the dilute acid. The difference in the absorption of these two cells was then due entirely to the bismuth atoms, since the absorption of the $(NO_3)_3 \cdot 5H_2O$ group added with each Bi atom almost exactly balanced that of the water and acid displaced. The cells had been balanced by trial and error, until their absorption was the same, both when they were filled with water and when they were empty. The solution was analysed to find the amount of bismuth, and the thickness of the cell was measured with a microscope, so that μ/ρ could be found. This was measured at twenty wave-lengths between 0·56 and 1·54 Å. By plotting these values, the equations of the four branches of the curve were obtained: $(\mu/\rho)(L_I) = 2{\cdot}438\lambda^{2\cdot5}$; $(\mu/\rho)(L_{II}) = 2{\cdot}548\lambda^4$; $(\mu/\rho)(L_{III}) = 2{\cdot}51\lambda^3$; $(\mu/\rho)(M) = 1{\cdot}860\lambda^{2\cdot715}$. The magnitudes of the discontinuities, r, where r(I,II) is the ratio of μ/ρ on the short wave-length side of L_I to that on the long wave-length side, are r(I,II) 1·161; r(II,III) 1·572; r(III,M) 2·393; r(I,M) 4·37. AUTHOR.

3780. X-Ray Diffraction in Cork. J. A. Prins. *Physica,* 1. *p.* 752, *June,* 1934. *In English.*—X-ray analysis indicates that cork is an amorphous ("liquid") substance of the nature of a polymerised aliphatic compound. J. S. G. T.

3781. X-Ray Diffraction in Liquid Mixtures. Part I. S. Parthasarathy. *Phil. Mag.* 18. *pp.* 90–97, *July,* 1934.—Observations of the diffraction of X-rays by mixtures of benzene and ethyl phthalate, pyridine and ethyl phthalate, ethyl phthalate and *m*-xylene, pyridine and ethyl benzene, acetic acid and *m*-xylene, and acetic acid and ethyl benzene indicate that the diffraction is produced by combined groups of the two kinds of molecule, which give rise to patterns with a single maximum. C. B. A.

3782. Intensity Measurements on X-Ray Spectral Lines of Tantalum. M. Bötzkes. *Zeits. f. Physik,* 89. 11–12. *pp.* 667–681, *July* 13, 1934.—The relative intensity of the tantalum L lines have been photographically and photometrically estimated, and compared with existing data for other elements. W. R. A.

See also Abstracts 3942, 3943.

HEAT.

CALORIMETRY.

3783. Specific Heats of Gases at High Temperatures. W. T. David and A. S. Leah. *Phil. Mag.* 18. *pp.* 307–321, *Aug.*, 1934.—Explosion experiments made in a large spherical vessel indicate the substantial accuracy of the mean values of the theoretical specific heats of: (1) H_2, CO, N_2, O_2, CO_2, and H_2O at 2000° C.; (2) CO, N_2, and CO_2 (and probably H_2 and O_2) up to 2500° C. There are indications that, if explosions were carried out at higher densities than 3 atmospheres, the theoretical specific heat values for CO, N_2, and CO_2, and probably also for H_2 and O_2, could be extended beyond 2500° C. The theoretical values for H_2O at temperatures above about 2000° C. require further investigation, but the inaccuracies resulting from their use will not be very considerable up to temperatures of 2200° C. Experiments only with mixtures at higher densities and with a still larger explosion vessel are suggested. AUTHORS.

3784. New Method for Determination of C_v, or J, and γ. R. Mohr. *Zeits. f. techn. Physik*, 15. 7. *p.* 284, 1934.—An adiabatic expansion method is described by which C_v, the specific heat at constant volume of a gas, may be determined in terms of J, the mechanical equivalent of heat. A method of obtaining γ, the ratio of the specific heats, by means of the same apparatus is also given. R. W. P.

3785. Calorimetric Studies at Extremely Low Temperatures. W. H. Keesom. *J. de Physique et le Radium*, 5. *pp.* 373–384, *July*, 1934.—The paper gives a very interesting survey of calorimetric work at liquid helium temperatures, recently carried out at Leyden. It has been found that at about 4° to 5° K. the specific heat of certain metals deviates from the Debye curve and it is suggested that the specific heat of the electrons may be responsible for this. The specific heat of supraconducting metals undergoes a discontinuity at the supra-conducting temperature and from comparison of the experimental results with theory it is concluded that the transformation is reversible. Thermometers for very low temperatures are also discussed and the interesting fact is mentioned that the resistance of magnesium increases with decrease of temperature over the range 1° to 4° K. The paper concludes with a thermodynamical discussion of liquid helium. L. G. C.

3786. Specific Heats of Zinc and Silver at Liquid Helium Temperatures. W. H. Keesom and J. A. Kok. *K. Onnes Lab. Leiden, Comm. No.* 232*d. Physica*, 1. *pp.* 770–778, *July*, 1934. *In English.*—Experiments were carried out in order to see whether the rapid descent of the $TC^{-1/3}$, T-curve below 5° K. is connected with adsorption of a layer of helium at the surface of the metal, by measuring the heat capacity (1) of a zinc block with increased ratio surface : weight, and (2) of a silver block cooled by contact so that no adsorption of helium at the low temperatures can occur. The result is negative, so that one is led to conclude that the effect mentioned is real. The hypothesis is introduced that the effect is due to the heat capacity of the free electrons. Below 3·0° K. the supplementary atomic heat for Ag agrees with the heat capacity of the free electrons according to Sommerfeld's formula, assuming for the number of electrons 1 per atom. Above 3·5° K. the heat capacity of the free electrons decreases rapidly. For Zn no definite conclusion can be reached. The supplementary heat seems to be of the order of magnitude that results from Sommerfeld's formula with $n = 1$, but the latter value appears to be rather too large. AUTHORS.

3787. Specific Heats of Thorium and Thorium Dioxide. F. M. Jaeger and W. A. Veenstra. *K. Akad. Amsterdam. Proc.* 37. 6. *pp.* 327–332, 1934.—The specific heats of the metal and of its oxide were measured by the method of mixtures. The atomic heat of massive thorium rises steadily with temperature, reaching the high value of 11·785 cal. per gm. atom at 1200° C. The atomic heat of the pulverised metal was found to be about 27 % greater than that of the massive metal. The molecular heat of the oxide has a flat minimum at 720°C. and thereafter rises rapidly, reaching 20·756 at 1400° C. The above values refer to constant pressure since the data necessary for conversion to constant volume are lacking. L. G. C.

3788. Isothermal Calorimeter. A. N. Schükarew, I. P. Kriwobabko and L. A. Schükarewa. *Phys. Zeits. d. Sowjetunion,* 5. 5. *pp.* 722–724, 1934. *In German.*—The ice in a Bunsen calorimeter is replaced by diphenylmethane. With suitable precautions this forms a convenient means of measuring heat changes in slow processes. The heat evolved during the hardening of cement over a period of 69 hours is thus measured. J. P. A.

See also Abstract 3809.

CONDUCTION.

3789. Solution of Heat Conduction from a Spherical Source by Method of Wave-Trains. J. Robertson. *Phil. Mag.* 18. *pp.* 165–176, *July,* 1934.—Refers to the application by Green [see Abstract 2585 (1930)] of the wave-train method to obtain a solution for several problems of heat flow including that in a finite sphere surrounded by a finite concentric sheath of different material. The present author uses the method to obtain a solution for the case in which the outer medium is of infinite extent. The paper is entirely mathematical. R. W. P.

3790. Thermal Resistivity and the Wiedemann-Franz Ratio of Single Crystal Zinc. C. A. Cinnamon. *Phys. Rev.* 46. *pp.* 215–221, *Aug.* 1, 1934.—The thermal resistivities at 57° C. are measured for thirteen large, strain-free, single crystals of zinc. The guard tube method is used with the heat applied at the centre of the specimen. The results show definitely that the thermal resistivity obeys the Voigt-Thomson symmetry relation. The principal resistivities are $\omega_0 = 0 \cdot 991$ and $\omega_{90} = 0 \cdot 936$ cm. deg. C./watt, with the ratio $\omega_0/\omega_{90} = 1 \cdot 058^8$. The close agreement of this value with the ratio of the principal electrical resistivities previously determined in this laboratory shows that the W–F ratio is the same for all orientations of the zinc crystal. The value of this ratio is $7 \cdot 15 \times 10^{-6}$ watt ohm/deg. C. at 57° C. and agrees within 11 % with the value predicted by the Sommerfeld theory. The two principal thermal conductivities are $\lambda_0 = 1 \cdot 009^2$ and $\lambda_{90} = 1 \cdot 068^4$ watts/cm. deg. C. at 57° C. Some observations are included on

" optically mosaic " crystals and on the effects of permanent strain on the single and mosaic crystals. AUTHOR.

3791. Thermal Resistance of Metal Single Crystals at Low Temperatures. W. J. de Haas and W. H. Capel. *K. Onnes Lab., Leiden, Comm. No.* 231*d. Physica,* 1. *pp.* 725–734, *June,* 1934. *In English.*—A new method for determining thermal resistance of metal single crystals at very low temperatures has been developed and is described in detail. A certain amount of energy per sec. is supplied electrically to one end of the rod to be examined and the temperatures of the two ends of the rod are determined by two vapour-tension thermometers, after the stationary state has been reached. Very pure Bi (99·995 % pure) is used for the preparation of the single crystals, the long axis of the rod being parallel to the trigonal principal axis. Several measurements are made in the temperature region of liquid hydrogen (16·5°K.–20°K.), and one in the region of liquid oxygen (81·4°K.). The results show that the change of conductivity of the crystals with temperature is in accordance with the general behaviour of very pure metals and diminishes with temperature down to the lowest temperature measured. There seems to be an indication that a minimum of thermal resistance may be reached at a still lower temperature. R. L.

3792. Heat Conductivity in Crystals. A. Papapetru. *Phys. Zeits.* 35. *pp.* 527–528, *July* 1, 1934.—The exact theory has been given by Peierls [see Abstract 1912 (1930)], but it was not possible to give there a complete mathematical solution, and the relation between thermal conductivity and temperature was determined only for the limiting cases of high and low temperatures. The author outlines a simplified treatment of the problem and arrives at an approximate formula valid for the whole temperature range. By inserting appropriate values his formula reduces at high temperatures to the $1/T$ law of Debye, and at low temperatures to the $1/T^2$ law. He tests his formula numerically for the cases of NaCl and KCl. R. L.

3793. Thermal and Electrical Conductivities of Metals and Alloys. Part I. Iron from 0° to 800° C. R. W. Powell. *Phys. Soc., Proc.* 46. *pp.* 659–678; *Disc.,* 679, *Sept.* 1, 1934.—A longitudinal-flow method has been used to determine the thermal conductivity, at mean temperatures ranging from 30° to 800° C., of a nickel-plated rod of Armco iron containing approximately 99·92 % of iron. After allowance for the effect of the nickel plating, and extrapolation to 0° C., a value of 0·177 c.g.s. units is obtained for the thermal conductivity of the iron. This value is higher than that usually attributed to iron, but a chemically prepared iron of greater purity has been examined also and found to have a thermal conductivity of 0·194 c.g.s. units at 0° C., and it seems evident that the lower results obtained by earlier investigators were due to the relative impurity of their specimens. The conductivity of Armco iron decreases with increase in temperature, the value at 800° C. being 0·071 c.g.s. units. By the use of values of the electrical conductivity which were determined during the same experiment as the thermal conductivity, the Lorenz function of this sample of iron has been calculated. It is found to increase from a value of $0{\cdot}62\times10^{-8}$ at 0° C. to the unusually high value of $0{\cdot}74\times10^{-8}$ at 400° C. and to remain approximately constant over the temperature-range of 400° to 700° C. AUTHOR.

See also Abstracts 3796, 3824.

CONVECTION.

3794. Force Produced on a Heated Fibre by Natural Convection. Y. Takenouti. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 106. *pp.* 337–384, *May*, 1934. *In English.*—Fine silk and glass fibres were suspended vertically from one arm of a sensitive balance, and the upward force due to the convection currents set up when the fibre was heated by radiant energy to a temperature T° in excess of that of the enclosure was measured. The measurements were made for several gases at various pressures, and it was found that the force could be represented by $A\rho CT/k$ where ρ, C and k are the density, specific heat and thermal conductivity of the gas, and A is a constant which varies with the dimensions of the fibre but is independent of the nature of the gas. R. W. P.

3795. Interchange of Heat and Mass for Mixtures of Two Substances. E. Kirschbaum. *Ann. d. Physik*, 20. 3. *pp.* 261–278, *June*, 1934.—In processes such as evaporation, solution and rectification a connection exists between the quantities of the substances involved and the heat transfer. On the basis of Fick's law a simple relation is obtained between the diffusion coefficients of the two substances. In the presence of convection the assumption that the transfer within the laminar layer occurs mainly by diffusion enables a connection to be established between the mass transfer coefficients of the two substances, and, finally, for the case in which one of the substances is deposited a connection between the mass and heat transfer is derived. The result is applied to the case of the condensation of water vapour on a vertical tube. R. W. P.

3796. Heat Transfer Involving Turbulent Fluids. W. A. Kaye and C. C. Furnas. *Indust. & Engin. Chem.* 26. *pp.* 783–786, *July*, 1934. —A theory is advanced to explain the difference between the film coefficients of heat transfer on heating and cooling fluids in turbulent flow in contact with solid surfaces. The relation between the two is a simple function of the mainstream viscosity. The theory gives a satisfactory correlation between the heating and cooling coefficients for oils and water flowing through conduits and for air flowing through beds of broken solids. AUTHORS.

DILATATION.

3797. Thermal Dilatation of Rock-Salt and Pure Sodium Chloride. H. Saïni. *Helv. Phys. Acta*, 7. 5. *pp.* 494–500, 1934. *In French.*—By the method previously described [see Abstract 707 (1934)] the coefficients of dilatation of pure NaCl, and of rock-salt have been determined. They are respectively: for 0°–140°, $35\cdot5\times10^{-6}+8\cdot9\times10^{-8}t$ and $35\cdot8\times10^{-6}+8\times10^{-8}t$, and for 140°–220°, 47×10^{-6} and $44\cdot5\times10^{-6}$. The two coefficients are identical at 40°, and independent of temperature above 140°. Agreement with previous results for rock-salt is good. The differences are ascribed to the slight impurities present in rock-salt. C. A. S.

See also Abstracts 3484, 3488.

MELTING AND BOILING POINTS.

3798. Melting-Curve of Nitrogen to 110 Kg./Cm². W. H. Keesom and J. H. C. Lisman. *K. Onnes Lab., Leiden, Comm. No.* 232*b*. *Physica*, 1. *pp.* 735–738, *June*, 1934. *In English.*—The melting-curve of nitrogen was determined in the range from the triple-point to 111·1 kg./cm.^{2} and 65·50° K. AUTHORS.

3799. Fusion Curves of the Systems Br_2-$CHCl_3$, Br_2-CCl_4 and $CHCl_3$-CCl_4. J. Sameshima and T. Hiramatsu. *Chem. Soc. Japan, Bull.* 9. *pp.* 260–262, *June,* 1934. *In English.*—Results of measurements of the freezing points of the systems Br_2–$CHCl_3$, Br_2–CCl_4 and $CHCl_3$–CCl_4 are tabulated and plotted. The first two systems show no evidence of a compound being formed, but in the third there is one compound $CHCl_3 \cdot 4CCl_4$ which has a melting point of − 55° C. R. W. P.

3800. Freezing Points and Vapour Pressures of HF-KF System. G. H. Cady. *Am. Chem. Soc., J.* 56. *pp.* 1431–1434, *July,* 1934.—Freezing-point and vapour-pressure measurements have been made using KF-HF solutions in which the mole fraction of the acid was greater than 0·46. In addition to three acid salts already known KF.4HF and 2KF.5HF have been identified. It has also been found that there are two solid forms of KF.HF. The data suggest that some of the solutions studied are particularly suited to be used as the electrolyte for the preparation of fluorine. AUTHOR.

3801. Freezing Points of Aqueous Solutions. Part VII. Ethyl Alcohol, Glycine and Their Mixtures. G. Scatchard and S. S. Prentiss. *Am. Chem. Soc., J.* 56. *pp.* 1486–1492, *July,* 1934.—A method is developed for the analytical expression of the thermodynamic functions of dilute solutions of several non-electrolyte components which reduces to a minimum the number of measurements necessary to determine the chemical potential (or activity) of any component in a solution of any composition. The freezing-point depressions of aqueous solutions of glycine, of ethyl alcohol and of two mixtures of them have been determined, and the above method applied to them. [For Part VI see Abstract 2554 (1934).] AUTHORS.

3802. Contamination of Platinum by Graphite. L. J. Collier. T. H. Harrison and W. G. A. Taylor. *Faraday Soc., Trans.* 30. *pp.* 581–587, *Aug.,* 1934.—A platinum ingot, heated *in vacuo* to its melting point in a graphite crucible, suffered within half an hour a depression of its freezing-point of about 40° K. This freezing point was thereafter found to be constant at 2007° ± 3° K. Subsequent examination of the ingot showed that approximately 1·2 per cent by weight of carbon was present. The greater part of this carbon was present in the form of graphite crystals. A polished section of the ingot, viewed under the microscope, had the appearance of a eutectic mixture of graphite and platinum. It was probable, that in addition, about 0·25 per cent of carbon was present in the platinum lattice in atomic form, producing a solid solution of graphite in platinum. There was no evidence of the formation of a compound of platinum and carbon. It would seem that graphite forms a eutectic with platinum and that in addition a small quantity of carbon is taken into solid solution, enlarging the platinum lattice. The freezing point of 2007° ± 3° K. would therefore be that of a eutectic mixture composed of (*a*) a solid solution of graphite in platinum, containing about 0·25 per cent by weight of graphite, and (*b*) pure graphite, present to the extent of about 1·2 per cent, by weight of the whole mass. AUTHORS.

3803. Cryoscopy of Milk. J. J. Ryan and G. T. Pyne. *Roy. Dublin Soc., Proc.* 21. *pp.* 113–122, *July,* 1934.—A cryoscopic constant is developed which takes account of the chief osmotic substances of milk (lactose, chlorides, phosphates and citrates), and shows close correspondence to the freezing point for various grades of milk. Methods for the various determinations required of refractive index, chlorides, and soluble phosphate, are discussed. The calcium nitrate serum is the most suitable for refractive index and chloride estimations, and a rapid and convenient method is suggested for the approximate determination of soluble phosphate by direct titration of milk. The determination of the constant in the case of milks to which known amounts of water have been added allows accurate calculation of the degree of dilution. N. M. B.

3804. Rule for Estimating Boiling Points at Different Pressures. Yun-Hua Li. *Chinese Chem. Soc., J.* 2. *pp.* 108–116, *June,* 1934. *In English.*—Existing rules for the estimation of boiling points at different pressures in terms of known values for a standard liquid often give results which are only approximately true. A more exact rule is derived and given in the following forms: (i) $T_s = KT_x^n$; (ii) logarithmic form of (i); (iii) $T'_x/T_x = (T'_s/T_s)^{1/n}$ where T_s and T_x are the boiling points in absolute temperatures of the standard and unknown liquids at the same pressures, and T'_x and T'_s the values at a second pressure, K is a constant, and n a characteristic constant equal in value to the ratio of the Trouton's constant of the unknown liquid to that of the standard liquid. Examples are given showing good agreement with published data. R. W. P.

3805. Supersaturation of Hot Water. H. B. Reitlinger. *Comptes Rendus,* 198. *pp.* 2290–2292, *June* 25, 1934.—An experiment is referred to, from which the following conclusion is claimed. If water is heated under pressure, almost to its boiling point, and the external pressure is then reduced below the saturation vapour pressure, copious emission of vapour does not immediately occur, but is retarded a time t after the equalisation of the two pressures. An empirical expression for t, in terms of the degrees of supersaturation of the water, is given. J. P. A.

3806. Volatilisation of Lithium Oxide at High Temperatures from Lithium Oxide-Silica Glasses. E. Preston and W. E. S. Turner. *Soc. Glass Technol., J.* 18. *pp.* 143–168, *June,* 1934.—The glasses were pure, ranging in composition from 10·12 to 50·09 per cent Li_2O (18 to 66 molecular per cent), and were characterised by a strong tendency towards devitrification. Under the experimental conditions employed, the range of volatilisation losses during the first 20 hours of heating in each case was (in mg./cm.^{2}): at 1400°, 2·25—120; at 1300°, 0·6—46; at 1200°, 0·15—5·3. At 1100°, owing to crystallisation in all others, measurements were only possible with glasses containing 20·53 and 22·88 per cent Li_2O. The temperature-volatility relationships approximated to a vapour-pressure law. The vapour pressures of the two highest members of the series were found to be for the 38·22 per cent Li_2O glass, 0·50 at 1300° and 0·73 mm. Hg. at 1350°; for the 50·09 per cent Li_2O glass, ·135 at 1300° and 3·74 mm. Hg. at 1400°. AUTHORS.

3807. Production of Absolute Alcohol. M. Pestemer and O. Gübitz. *Naturwiss.* 22. *pp.* 504–509, *July* 27, 1934.—The distillation methods due to Young and Keussler for the production of absolute alcohol are described. These are similar in that they are both based on the distillation of a ternary mixture of benzene, alcohol and water, but Keussler's process is conducted under a pressure of 10 atmospheres. Boiling-point curves are given, and also the compositions and boiling points of several ternary azeotropic mixtures, containing various organic substances in addition to alcohol and water, to which similar methods might be applied. R. W. P.

See also Abstracts 3812, 3876.

TEMPERATURE, MEASUREMENT OF.

3808. Regularity of Graduation of a Thermometer. P. Vernotte. *Comptes Rendus,* 198. *pp.* 2230–2232, *June* 25, 1934.—Thermometers are often used to measure small variations in temperature and although the actual thermometer graduations may be in error, measured on the absolute scale, accurate readings are possible if the variation in temperature read on the thermometer, dN, is the same as the variation on the absolute scale, dT. A calorimetric method is described for measuring $\frac{dN}{dT}$ directly. An example is given of a series of measurements on two thermometers. From the readings the degree of fidelity of the thermometer scale may be deduced and, if required, corrections may be made to the scale. H. J. H. S.

3809. Reference Temperatures for Thermels, Especially in Calorimetry. W. P. White. *Rev. Sci. Instruments,* 5. *pp.* 269–275, *Aug.,* 1934.—A " cold calorimeter," that is, a Dewar bottle in a thermostat, used to contain the rear end of a calorimetric thermel, gives much of the advantage of the Joule-Pfaundler twin calorimeter with greater simplicity, and enhances the precision and the convenience which characterise the thermel in calorimetry. The best and surest form in nearly every respect is a Dewar bottle of water, under an inverted cup or diving bell, all submerged in the thermostated bath. With a bath regulated to 0·0002° a pint Dewar, whose thermal leakage modulus should be well under 0·0006, will show a change of 0·00007° for each hour at the worst. A special arrangement of thermels will increase the precision ten times or more, while adding not a single reading to those regularly made for the working calorimeter. A pint Dewar in a gallon Dewar with a thermostated bath will give 0·0001° constancy over 10 hours, with almost no attention. AUTHOR.

3810. Speed of Response of a Thermopile-Galvanometer System. A. V. Hill. *Journ. Sci. Instruments,* 11. *pp.* 246–247, *Aug.,* 1934.—The rapidity of deflection of a galvanometer attached to a thermopile suddenly exposed to radiation varies with the speed of the galvanometer and the speed of the thermopile. The purpose of this note is to show how it depends upon these two factors, and their relative importance. AUTHOR.

3811. Thermoelectric Cells. R. V. Jones. *Journ. Sci. Instruments,* 11. *pp.* 247–257, *Aug.,* 1934.—The theoretical sensitivity and response time of thermopile circuits and the practical design of thermopiles are considered, and it is concluded that a single element uncompensated pile is best for many purposes. The construction of thermoelectric cells, of two types, is described. In each of these the thermoelement is clamped in a copper case, which acts as a screen against stray radiation, as a reflector, and as massive cold junctions. The first type employs a Bi/Sb-Cd alloy hot junction, the metals being made into wires by the Taylor process. The other type contains a Bi-Sb junction ; the receiver is of thin gold leaf. The thermoelectric metals are distilled on to glass films 0·5μ thick, which support them. The second type is much stronger and quicker in response than the first, but is less sensitive. The cells are operated in a vacuum of

10^{-4} mm. Hg; this ensures steadiness in operation. A simplified form of cell dispensing with the copper case and employing a distilled element is described. The use of these thermoelements as modified Pirani gauges is suggested. A typical Bi/Sb-Cd alloy cell had a receiving area of 0·05 $cm.^2$, a resistance of 8 ohms, and developed an e.m.f. of 55 μV for the radiation from a candle at 1 m.; its response time was 6 sec. The other type had about ¾ of this sensitivity, and a response time of 2·5 sec. AUTHOR.

3812. Adiabatic Cooling of Magnetic Substances. W. J. de Haas and E. C. Wiersma. *Physica*, 1. *pp.* 779–780, *July*, 1934. *In English.*—A preliminary account is given of a new cryostat in which it is possible to obtain a larger volume at a homogeneous temperature and to avoid time-lag in the magnetic measurements. The technique adopted with the new apparatus is illustrated with an experiment on potassium chromium alum in a field of 24,600 G. Adiabatic cooling reduced the temperature from 1·16° K. to 0·013° K. [See also Abstract 714 (1934).] H. J. H. S.

3813. Air-Pressure Driven Water Circulator. W. P. White. *Rev. Sci. Instruments*, 5. *pp.* 275–276, *Aug.*, 1934. The circulator was made in order to move water through a vessel under the surface of a bath. Since the bath was thermostated with considerable precision the cooling effect of bubbling air through the water was undesirable. The present apparatus, needing no motor, gears or special supports, has some advantage over a pump. It is very easily made from the commonest laboratory supplies. AUTHOR.

THERMOCHEMISTRY.

3814. Heats of Crystallisation of Hydrated Salts from Slightly Supersaturated Solution. J. Perreu. *Comptes Rendus*, 199. *pp.* 48–51, *July* 2, 1934.—The heats of crystallisation from a slightly supersaturated solution have been determined for ten hydrated salts:—hydrated MSO_4 (M = Na_2, Cu, Mg, Ni, and Zn), $BaCl_2$, $MnCl_2$, Na_2CO_3, $Na_2S_2O_3$, and Na_2HPO_4. The results agree accurately with the limiting heats of solution of the same salts. C. A. S.

3815. Heats of Combustion and of Formation of the Normal Paraffin Hydrocarbons. F. D. Rossini. *Bureau of Standards, J. of Research*, 13. *pp.* 21–35, *July*, 1934.—From the data recently obtained in this laboratory on the heats of combustion of methane, ethane, propane, normal butane, and normal pentane, reliable values are deduced for the heats of combustion of all the other normal paraffin hydrocarbons in the gaseous state. For normal C_nH_{2n+2} (gas), with $n > 5$, the heat of combustion, at a temperature of 25 ° C. and a constant total pressure of 1 atmosphere, in gaseous oxygen to form gaseous carbon dioxide and liquid water, is $60{\cdot}40 + n\ (157{\cdot}00 \pm 0{\cdot}08)$ k.cal./mol. From these and other data values are computed for the heats of formation, from hydrogen and β-graphite and diamond, respectively, of all the normal paraffin hydrocarbons in the gaseous state at temperatures of 25° C. and 0° K. The energy of dissociation, at the absolute 0, of a geseous normal paraffin hydrocarbon, C_nH_{2n+2}, into gaseous carbon and hydrogen atoms, is shown to be a linear function of n above, but not linear below, $n = 6$. The deviations from linearity for the latter are in the direction of greater stability of the molecule and have the following values: Methane, 4·81 ±

0·08; ethane, 1·59 ± 0·14; propane, 0·83 ± 0·19; normal butane, 0·46 ± 0·27; normal pentane, 0·13 ± 0·37, k.cal./mol. AUTHOR.

3816. Heats of Combustion and of Formation of Normal Aliphatic Alcohols. F. D. Rossini. *Bureau of Standards, J. of Research,* 13. *pp.* 189–202, *Aug.*, 1934.—The existing data on the heats of combustion and of vaporisation of the normal aliphatic alcohols are correlated with the value recently proposed by the writer for the increase in the heat of combustion per added CH_2 group. Selected " best " values are given for the heats of vaporisation at 25° C.; for the heats of combustion of the gas and the liquid at 25° C.; for the heats of formation from solid carbon and gaseous hydrogen and oxygen at 25° C. and at zero Kelvin; and for the heat of the reaction C_nH_{2n+2} (gas) $+ \frac{1}{2}$ O_2 (gas) $=$ $C_nH_{2n+1}OH$ (gas) at 25° C. and at zero Kelvin. The energy of dissociation at absolute zero, of the normal aliphatic alcohol, $C_nH_{2n+1}OH$, into its constituent atoms is found to be a linear function of the number of carbon atoms above, but not below, n equal to about 6. The deviations from linearity are in the direction of lesser stability of the molecule and have the following values, in k.cal. per mole: methanol, — 3·78 ± 0·10; ethanol, — 1·18 ± 0·20; normal propanol, —0·60 ± 0·40; normal butanol, —0·30 ± 0·55; normal pentanol, — 0·15 ± 0·70. The deviations can be explained by distinguishing different kinds of C–H, C–C, and C–O linkages in these molecules. AUTHOR.

3817. Heats of Combustion of Organic Sulphur Compounds. G. Becker and W. A. Roth. *Zeits. f. phys. Chem.* 169. *Abt.A.* 3–4. *pp.* 287–296, 1934.—Since the thermochemistry of sulphur is now established by means of the reaction, $([S]_{\text{rhomb}} \rightarrow H_2SO_4 \cdot nH_2O)$, the thermal data for sulphur-containing organic compounds may now be determined much more accurately than hitherto. The sources of error involved by combustion in the bomb (catalytic and otherwise) are discussed, and, on practical grounds, the dilution $H_2SO_4 \cdot 10{,}000\ H_2O$ is proposed for expressing the combustion of rhombic sulphur. The tables, curves and formulæ are all based on this concentration, and complete data are given for cystin, cystein and thiourea. H. H. Ho.

3818. Rôle of Charged Particles in the Propagation of Flames. A. Sokolik and B. Skalow. *Phys. Zeits. d. Sowjetunion,* 5. 5. *pp.* 676–686, 1934. *In English.*—The effect of transverse electrical fields on the propagation of " normal " combustion in mixtures of C_2H_2, C_6H_6 and CO with air is investigated by a photographic method. The change in flame velocity for applied fields up to 18 kV shows characteristic maxima in the velocity of propagation in CO. Flame extinction in smokeless flames is recorded. Special effects are found in the passage of flames through negatively charged diaphragms. Two explanations of the results are suggested on the basis of the hypotheses of Thomson and Jones, Morgan and Wheeler. H. J. H. S.

3819. Limits of Detonation of Gaseous Mixtures. P. Laffitte and J. Breton. *Comptes Rendus,* 199. *pp.* 146–148, *July* 9, 1934.—The limits of mixtures of various gases which would give an explosion wave were studied by means of the Mallard and Le Chatelier method. The explosion was started by means of a detonator of mercury fulminate, and was propagated in a copper tube of 14 mm. dia. and 5 m. long. The detonation of mixtures of H_2 and O_2, H_2 and air, and mixtures of these containing CO was studied. The results were recorded photographically. F. J. B.

3820. Influence of Pressure on the Spontaneous Ignition of Inflammable Gas-Air Mixtures. Part III. Hexane and Isobutane Air Mixtures. D. T. A. Townend, L. L. Cohen and M. R. Mandlekar. *Roy. Soc., Proc.* 146. *pp.* 113–129, *Aug.* 1, 1934.—Previous work on the influence of varying initial pressure up to 15 atmospheres on the spontaneous ignition of butane- and pentane-air mixtures [see Abstract 270 (1934)] is now extended to hexane- and isobutane-air mixtures. The ignition points have been found to lie in two well-defined temperature ranges, location in the higher range occurring at low pressures, and in the lower range at higher pressures. Transference of the ignition points from the higher to the lower range occurred at a critical pressure which depended upon mixture composition, and for rich mixtures was as follows: butane (1·75 atms. from 450° to 370°), iso-butane (3·25 atms. from 390° to 370°), pentane (1·25 atms. from 490° to 350°) and hexane (0·9 atms. from 495° to 350°). It is opined that the lower group of ignition points is the outcome of the rapid oxidation of certain intermedially formed oxygenated bodies the survival of which is favoured by high pressures; the higher group results from ignitions of mainly the products of the thermal decompositions which are favoured by low pressures. This is supported by the fact that aldehydes promote ignition in the lower temperature range but hardly at all in the higher range; moreover, a normal paraffin is far more easily ignitable in the lower temperature system than a correspondingly oxide-chained isomer, the oxidation of which is known to give rise to fewer aldehydes. Knock in an engine is probably conditioned by a compression ratio adequate to promote ignition in the lower temperature range; this compression ratio is raised by the presence in the medium of an antiknock.
H. H. Ho.

3821. Production and Temperature of Stationary Coal Dust and Coal Dust-Gas Explosions. E. A. Fuhrmann and H. Köttgen *Zeits. f. phys. Chem.* 169. *Abt.A.* 5–6. *pp.* 388–415, 1934.—Part I of this paper, by the first-named author, deals with coal dust flames, and a laboratory method is described for their production and for a study of explosions. Gas coal from Upper Silesia was used in the experiments. The form of the flames and the temperature distribution as ascertained by pyrometric measurements are discussed; and the dependence of the temperature on the size of the dust particles is derived. The peculiar temperature-curve form of the explosion flame enables the close connection of the gas and dust explosions to be recognised. Part II, by the second author, considers flames, currents and temperatures of mixed coal dust-gas explosions, and a laboratory method is described for the production of such explosions. The behaviour of coal dust-methane flames is investigated for change of explosive mixture, current relationships and ignition procedure. The temperature distribution in the flames as evaluated pyrometrically is discussed and a dependence of temperature on methane content is established. The explosion zones may be fixed both by chemical and physical means.
H. H. Ho.

See also Abstracts 3466, 3467, 3538, 3783, 3825.

THERMODYNAMICS.

3822. Establishment of the Second Law of Thermodynamics by Cyclic Processes. H. Hausen. *Phys. Zeits.* 35. *pp.* 517–524, *July* 1, 1934.—Relatively simple and direct cyclical processes for the interpretation of the significance of entropy and the principle of increase of entropy are discussed. J. S. G. T.

3823. Temperature Variation of the Second Virial Coefficient of Helium. N. G. Whitelaw. *Physica,* 1. *pp.* 749–751, *June,* 1934. *In English.*—Calculated values of B in the equation of state for helium, *viz.*, $PV/RT=A+B/V+\ldots$, based on results due to Roebuck and Osterberg are found to confirm Keesom and van Senten's determinations. J. S. G. T.

3824. Friction, Heat Conduction and Diffusion in Gaseous Mixtures. Part XXIX. M. Trautz. *Ann. d. Physik,* 20. 3. *pp.* 313–327, *June,* 1934.—From data already known it is first shown that the critical volume is proportional to the molecular volume derived from viscosity experiments, except for the lightest gases. With the same exceptions, the law $RT.d\log P/d\log T=W$, a constant, is found to hold for the part of the vapour-pressure curve in which the pressure exceeds 1 atmosphere, and up to the critical temperature T_k; above T_k, W is asymptotic to RT. By combining these results with those of van Laar for the molecular volumes, values of the critical volumes may be derived from the vapour-pressure curves. A list calculated thus shows close agreement with observed values except for gases having molecular dipoles, or which are paramagnetic. These results are discussed, and it is shown that if the constant volume during an experiment is the critical volume, the P-T curve has a point of inflection at the critical point. [See also Abstract 3335 (1934).] J. P. A.

3825. Van der Waals Forces in Liquid Mercury and in Hg_2. H. Ekstein and M. Magat. *Comptes Rendus,* 199. *pp.* 264–266, *July* 23, 1934.—Using Born's formula, $\epsilon=-a/r^m+b/r^n$ for the potential between two molecules, with $m=6$, and the values of a as calculated by London (3395 k.cal.), Slater and Kirkwood (5830), and Born (3395 × 1·5) [see Abstracts 1464 and 2367 (1931) and 2717 (1932)], the values of n are found to be respectively 16·3, 10, and 10·4; the distances between two isolated atoms of Hg for minimum potential 3·28, 3·49, and 3·38 Å, as compared with 3·20 for the minimum distance between neighbouring molecules at absolute zero; and the energies of dissociation of the unexcited molecule Hg_2 1·93, 1·27, and 1·46 k.cal., as compared with Koernicke's (1·38) and Kuhn's (1·6) experimental values [see Abstract 3736 (1932)]. C. A. S.

3826. Thermodynamic Properties of Fused Salt Solutions. Part VIII. Lead Chloride in Silver Chloride. E. J. Salstrom. *Am. Chem. Soc., J.* 56. *pp.* 1272–1275, *June,* 1934.—E.M.F. measurements have been made with the cell Ag (solid)|$AgCl,PbCl_2$(liquid)|Cl_2(gas) at temperatures from 460° to 620° C. and at 100 to 10 mol. % AgCl in the liquid phase. Density determinations lead to the expression $d^{t°}=5{\cdot}547-0{\cdot}00128t$ for 50 mol. % solutions of AgCl and $PbCl_2$ between 428° and 576° C. Various thermodynamic properties, including the activity, activity coefficient, free energy of formation, and partial molar free energy, have been calculated for AgCl at 500° and 600° C. On the assumption that Raoult's law is valid for the solutions, and that both salts are un-ionised, the calculated and observed values for the free energy of solution are in very close agreement; the assumption that both salts are completely ionised leads to only small divergence between the calculated and observed values. [For Part VII see Abstract 2502 (1933).] H. F. G.

See also Abstracts 3505, 3784, 3785, 3801, 3872.

V.
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VAPOUR PRESSURE.

3827. Vapour Pressures of Ethyl Nitrate, Ethyl Nitrite and Nitroethane. Janet W. Goodeve. *Faraday Soc., Trans.* 30. *pp.* 501–503, *July*, 1934.—Vapour pressures have been measured over the temperature range—80° to 20° C. An accuracy of 0·02 mm. of Hg being obtained by allowing the displacement of the pressure gauge to be followed by a differential selenium photo-cell moved by a micrometer screw. The results obtained are represented by the following equations: Ethyl nitrate, $\log_{10} P = -2010/T + 8 \cdot 57$; ethyl nitrite, $\log_{10} P = -1453/T + 7 \cdot 88$; nitroethane, $\log_{10} P = -1985/T + 8 \cdot 01$, where T is the absolute temperature and P the pressure in mm. of Hg. R. W. P.

3828. Pressure of Saturated Water Vapour in the Range 0° to 374° C. N. S. Osborne and C. H. Meyers. *Bureau of Standards, J. of Research*, 13. *pp.* 1–20, *July*, 1934.—Recent determinations of the vapour pressure of water have enriched our knowledge of this property sufficiently to justify revision of the accepted values. A formula has been developed which by a single equation represents the available data; and defines explicitly the relation of saturation pressure to temperature between the freezing point and the critical region. Graphical comparisons of the original data with the formula indicate the degree of confidence which may be given to the adjusted values. Comprehensive tables of pressures, derivatives, and boiling points, computed by use of the formula, are given in several customary units for convenience in compiling complete tables of thermal properties of steam. A table of conversion factors is given. AUTHORS.

3829. Vapour Pressure of Small Liquid Drops. I. Kritschewsky. *Kolloid Zeits.* 68. *pp.* 15–16, *July*, 1934.—A correction in the Thomson equation for the vapour pressure of small liquid drops is derived, which takes into consideration the volume change of the liquid during dispersion, *viz.*, $RT \log p/p_0 = 2\gamma v_0/(r - 3K)$ instead of $RT \log p/p_0 = 2\gamma v/r$, where R is the gas constant, T the absolute temperature, p the vapour pressure over the drops, p_0 the vapour pressure over the flat liquid surface, γ the surface tension at the boundary liquid-vapour, v the molecular volume of the liquid, r the radius of the drop, and K a constant which is $\partial v/\partial \omega$, *i.e.*, the volume change with surface (ω). H. H. Ho.

See also Abstracts 3800, 3805, 3806, 3824.

ACOUSTICS.

3830. Lines of Vibration and Variations of Pressure Amplitude Inside Sonorous Cavities. M. Marty. *Ann. d. Physique,* 1. *pp.* 622–655, *May–June,* 1934.—The lines of vibration near an orifice are determined in some cases by observing the motion of suspended dust particles, and in others by drawing lines normal to Kundt's dust figures. The lines obtained near an orifice have the form of the lines of flow of a perfect fluid as given by hydrodynamical equations. The greater part of the paper is taken up with a description of measurements of the pressure amplitude inside various forms of resonator. The instrument employed is a modification of the Kundt valve. A copper tube of 4 mm. dia. is closed at one end by a pointed stopper. Near this end the tube is slightly flattened and pierced by a hole of 2 to 3 mm. dia. The hole is covered by a strip of gold-beater skin which is stuck to the tube at the ends, thus forming a valve which allows air to pass out of the tube. The tube contains a cotton wick. The tube is adjusted on the axis of the resonator with the valve hole at the point where the pressure difference is to be measured. The other end of this search-tube is connected to one limb of a water manometer and the other limb of the manometer is connected to a point in a loop or neutral segment within the same resonator. The pressure difference is thus obtained in cm. of water and may amount to 40 cm. in some cases. With this apparatus, pressure graphs are found for stationary waves in cylinders, cones, spheres, and other forms of resonator.

G. E. A.

3831. Acoustical Interference Effects. H. E. Meier. *Phys. Zeits.* 35. *pp.* 524–527, *July* 1, 1934.—A description is given of a method of demonstrating interference effects with h.f. sound generated by a Galton whistle. The whistle is mounted at the focus of a parabolic mirror which is sufficiently deep to collect more than half the acoustical output of the whistle. The sound is detected by a sensitive flame placed at the focus of a similar mirror. In this way diffraction effects produced by a six-element grating can be demonstrated. Using a special design of whistle and by reflecting the sound back *via* a plane reflector it is possible to demonstrate the effect of reaction upon the source, it being possible to make the acoustical output nearly zero. Similar effects can be produced by using the whistle between two plane reflectors. J. E. R. C.

3832. Sources of Error in Sound Investigations. Part I. Temperature Gradient in Front of the Transmission Quartz. C. Bachem and E. Hiedemann. *Zeits. f. Physik,* 89. 7–8. *pp.* 502–505, *June* 16, 1934.—Sources of error which may occur in the authors' method of making visible various sound waves are considered. Enlargement of the interval between the wave-fronts in front of the transmission quartz may occur due to the temperature fall in a liquid traversed by sound waves which causes deviation of the bundle of light rays used in the investigation. The control of ultrasonic transmitters by means of a quartz is dealt with. [See Abstract 2581 (1934).] J. J. S.

3833. Acoustical Properties of Building Materials. F. Spandöck. *Ann. d. Physik,* 20. 3. *pp.* 328–344, *June,* 1934.—Very brief groups of sound waves of frequencies 800 and 4000 c.p.s. are emitted by a loud-speaker in the direction of a microphone. After passing the microphone they are reflected normally by a large plane of the material. From the oscillograph records of the microphone reception, the reflecting and transmitting powers of the material may be calculated. Experiments on the diffraction round a small obstacle are also made, and a brief mathematical Appendix follows. J. P. A.

3834. Acoustical Insulation Afforded by Double Partitions Constructed from Similar Components. J. E. R. Constable. *Phil. Mag.* 18. *pp.* 321–343, *Aug.*, 1934.—A theoretical and experimental study has been made of the acoustical insulation afforded against air-borne sound by double partitions constructed from similar components. In the case of singly resonant rigid partitions a relation is derived connecting the sound reduction due to a double partition with that due to one of its components. It is shown that the relation represents with reasonable accuracy the results for a rectangular double glass partition studied experimentally. It is deduced and confirmed experimentally that at the lower frequencies an increase of the spacing between two air-separated components may decrease the acoustical insulation. It thus happens with double glass windows, and may occur with other double structures, that there is a range of frequencies over which the acoustical insulation is less than that afforded by one of the components. AUTHOR.

3835. Variation of Sound Absorption with Area. V. L. Chrisler. *Bureau of Standards, J. of Research,* 13. *pp.* 169–187, *Aug.*, 1934.—This paper contains a report of work on sound absorption where large areas of absorbent material are installed. The measurements show that under these conditions it is impossible to obtain a logarithmic decay, hence the sound absorption is less than would be expected from the absorption coefficient of the material. Measurements were also made on very small areas. In this case the absorption was more than would be expected from the coefficient determined by measuring the absorption of an area of 72 ft.^{2} AUTHORS.

3836. New Hydrodynamic Theory of a Sensitive Flame. H. Zickendraht. *Helv. Phys. Acta,* 7. 5. *pp.* 468–470, 1934. *In German.*—In the first part [see Abstract 682 (1933)] the author describes a form of sensitive flame which can be considered as a sound receiver. In the hydrodynamic sense, the flame is a jet at the limit between steady and turbulent flow. C. A. Bjerknes's theory of hydrodynamic force at a distance has been applied for very weak sounds, from which two undisturbed positions of the flame per period of the incident sound are expected ; usually, however, only one such position per period is seen by a revolving mirror or by photography. This is probably due to asymmetry. H. M. B.

3837. Application of Sound Measuring Instruments to the Study of Phonetic Problems. J. C. Steinberg. *Acoustical Soc. of America, J.* 6. *pp.* 16–24, *July,* 1934.—This paper gives the results of a period-by-period analysis of the vowel sound waves occurring when the sentence " Joe took father's shoe bench out " was spoken. Such an analysis gives an approximate picture of the time variations in r.m.s. amplitude of the wave, frequency of voice fundamental, and frequency regions of overtone reinforcement. Although the study is confined to a few sounds and one speaker's voice, it illustrates a method of approach to studies of speech production and measurement. AUTHOR.

3838. Gault Teletactor. L. D. Goodfellow. *Acoustical Soc. of America, J.* 6. *pp.* 45–50, *July*, 1934.—A résumé of researches on the development of this apparatus [see Abstract 744 (1934)]. Provided the intensity of stimulation be sufficient vibrations up to 8000 c.p.s. may be detected and, in fact, experiments indicate that the physical characteristics of speech may be appreciated. Efforts to determine the rôle played by the sensations of touch and of vibration respectively are reported together with descriptions of experiments designed to test ability to interpret complex vibratory patterns. A Bibliography of papers, published mainly in journals of non-physical science, is appended. E. J. I.

3839. Sound-Absorption Coefficients. R. F. Norris. *Acoustical Soc. of America, J.* 6. *pp.* 43–44, *July*, 1934.—By examining published results the author shows that the measured absorption coefficient of a sample of celotex is approximately a linear function of the logarithm of the area tested; and that some 600 sq. ft. of material should therefore form a perfect reflector. This absurdity, ascribed to experimental error and not to the more usual explanations of edge-effect, angle of incidence, etc., does not arise when the author's method of comparing the sound pressures set up by a source in an enclosure containing a substance of (*a*) known, and (*b*) unknown absorption, is used to determine coefficients. E. J. I.

3840. Sound Transmission by an Organ Case. J. Schumacher. *Zeits. f. techn. Physik,* 15. 7. *pp.* 274–279, 1934.—The organ is heard *via* its elaborately carved wooden front and the sound transmission through 25 typical sections of this front was measured *in situ* at frequencies ranging between 200 and 3000 ∼. A number of curves are reproduced showing the variation of transmission with frequency for selected sections and their characteristics are correlated with the contruction of the sections. It is concluded that it is important to arrange that the design of organ fronts of this type should be such that the case is pierced frequently all over its surface. J. E. R. C.

3841. Harmonic Analysis of Sound-Frequency Oscillations with a Stroboscopic Disc. T. d. Nemes. *Phil. Mag.* 18. *pp.* 303–307, *Aug.*, 1934.—The experimental arrangement described demonstrates the function of the stroboscopic disc in general cases. The disc is used for showing not only the presence of the fundamental of any oscillation, but also for giving the harmonics quantitatively and simultaneously. AUTHOR.

3842. Acoustics. E. Meyer. *Die Physik,* 2. 3. *pp.* 97–122, 1934.—A review is given of recent acoustical work. The subjects treated are: general acoustics (sound generation, radiation and reception); methods of measurement; electro-acoustics (microphones, loud-speakers, wireless, sound signalling and sound recording); musical instruments; building acoustics; physiological acoustics; noise measurement and prevention; ultrasonics. J. E. R. C.

3843. Sound Radiation from a Condenser Discharge. W. McFarlane. *Phil. Mag.* 18. *pp.* 24–46, *July*, 1934.—Measurements of the sound energy radiated from an oscillatory discharge are described. The energy is deduced from the impulse given by the sound wave to a small torsional ballistic pendulum. The impulse, P, appears to be given by $AV^2\sqrt{C/LR}$, where V is the p.d., C, L and R the constants of the oscillatory circuit, and A a constant for any given electrodes. The discharge of a small capacity with a high p.d. is much more efficient as a sound producer than a large capacity at a low potential, the total energy supplied being the same. J. E. R. C.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

3844. Bridge Method for Measuring the Coupling Coefficient of an Air-Core Transformer. L. M. Chatterjee. *Zeits. f. Physik,* 89. 9–10. *pp.* 601–604, *June* 26, 1934.—The paper describes the use of Heydweiller's modification of Carey Foster's capacitance-mutual inductance bridge for the measurement of the coupling coefficient of the mutual inductance. One condition of balance gives the ratio (M/L_1) of the mutual inductance (M) to the self-inductance (L_1) of the secondary coil, which is included in one of the bridge arms. A simple switching arrangement is then used to interchange the secondary and primary coils, balance being restored by adjusting the resistance in series with the condenser. In this way the ratio M/L_2 is found, L_2 being the self-inductance of the primary. The deduction of the coupling coefficient K ($= M/\sqrt{L_1L_2}$) then follows simply. [See also Abstract 5000 (1933).] N. F. A.

See also Abstract 3515.

CONDUCTION AND DISCHARGE IN GASES.

3845. Mercury High-Pressure Discharge. W. Elenbaas. *Physica,* 1. *pp.* 673–688, *June,* 1934. *In German.*—The mercury high-pressure discharge can be described by assuming a temperature equilibrium between Hg-atoms, -ions and electrons. With the gas temperature, determined as formerly described [see Abstract 1672 (1934)], the current can be calculated for a given voltage gradient. by making use of the ionisation formula of Saha and the mobility-equation of Langevin. Using the same picture, the contraction of the discharge and the absolute value of the light intensity may be calculated. The results are in good agreement with the experiments. AUTHOR.

3846. Breakdown in Compressed Gas in Inhomogeneous Electric Fields. I. Goldmann and B. Wul. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. *pp.* 545–547, *June* 21, 1934. *In German.*—Experiments on breakdown voltage are described in compressed nitrogen in inhomogeneous fields. The electrodes used for this purpose are a needle of Pt wire of 0·435-mm. dia. and a round brass plate of 120-mm. dia., and the electrode distances are small, of the order of 1 cm. Graphs are given of the results showing relation between breakdown voltage and gas pressure, up to about 16 kg./cm. for various electrode distances for alternating voltage, direct voltage and impulse voltage, and with both positive and negative needle. An interesting maximum is observed in the breakdown voltage—pressure curve, and the results are discussed. R. L.

3847. Initial Stages of Spark Discharges in Gases. H. J. White. *Phys. Rev.* 46. *pp.* 99–106, *July* 15, 1934.—The electro-optical shutter is used to study spark breakdown in N_2, H_2, O_2, CO_2, He and A at atmospheric pressure and for gap lengths up to about 1 cm. Four distinct types of breakdown, as characterised by the appearance and growth of the luminous streamers, are recognisable in these gases. The velocities of the streamers emanating from the kathode in the cases of H_2 and N_2 have been measured and have been found to be about 10^7cm. per sec., which is of the order of magnitude of the calculated velocities of electrons in these gases under breakdown conditions. Pencil drawings representing the course of the breakdown in H_2, N_2, He and A are reproduced. Photographs of single sparks in early stages are shown for N_2, O_2 and CO_2, the exposure time for some of these being as short as 5×10^{-9} sec. The experiments indicate that the major portion of the current passing during breakdown is carried by electrons, and that these, for the most part, come from the kathode rather than from ionisation in the gas. The shortness of the spark lag, and the breakdown times of the sparks, show that the phenomenon is essentially due to the motion of electrons, and that the space charges which cause breakdown result from the large difference in the mobility velocities of electrons and positive ions. A theory is formulated to explain the appearance and growth of the streamers observed in certain gases, such as N_2. AUTHOR.

3848. Thermic Mechanism in the Column of the Arc Light. L. S. Ornstein and H. Brinkman. *Physica*, 1. *pp.* 797–824, *July*, 1934. *In German.*—It is shown that in the ordinary arc light the impacts between atoms and molecules are by far the most important cause of the generation and extinction of excited particles, while the impacts of particles with electrons and ions and the emission and absorption of radiation play quite a subordinate part, as is also the case with ionisation and dissociation processes. The thermic mechanism of the arc discharge leads to Boltzmann's law for the distribution of the molecules and atoms among the different energy states, with the gas temperature as the distribution modulus. The equilibrium between ions, electrons and neutral particles is given by Saha's ionisation formula, but it is found that the velocity distribution of the neutral gas particles and of the electrons does not depart much from the Maxwellian distribution for the temperature of the gas. It is shown that the gas temperature can be derived from measurements of the arc temperature and intensity measurements in the arc spectrum. The conditions of the change-over from the arc to the glow discharge and also departures from Boltzmann's law are discussed. Finally, the possibility of a discharge of the arc type in the rare gases is considered, but this appears improbable since for these gases the discharge mechanism is not of the thermic type. A. W.

3849. Electric Arc. F. H. Newman. *Phil. Mag.* 18. *pp.* 365–368, *Aug.*, 1934.—The author discusses briefly various theories of the electric arc and suggests that the starting of an arc under conditions where the electrodes are separated and a momentary electrical discharge is passed probably occurs in the following manner. When the high tension (electrical discharge) is suddenly applied the bombardment of the kathode active spots by the positive ions results in thermionic emission therefrom. Ionisation occurs in the kathode fall space with the high applied field, and the positive ions form a dense positive space charge which produces the requisite electric field for cold emission. It is stated that this does not preclude some thermionic emission from the active spots. R. L.

3850. Silvering of Mirror Surfaces by Kathode Sputtering. M. Romanowa, A. Rubzow and G. Pokrowsky. *Phys. Zeits. d. Sowjetunion*, 5. 5. *pp.* 746–760, 1934. *In German.*—A method of preparing silvered mirror surfaces by kathode sputtering is described. The silvering was carried out in hydrogen at pressures of 0·04–0·05 mm., which were maintained by a Langmuir glass pump. The optical properties of the mirror surfaces were determined, and very high reflective powers were observed. F. J. B.

3851. H.F. Currents in Ionised Gas. Angelika Székely. *Ann. d. Physik*, 20. 3. *pp.* 279–312, *June*, 1934.—After comparing with theoretically derived equations the results of previous workers, mainly those investigating wireless transmission, laboratory experiments with ionised A at 10^{-3} mm. pressure over a frequency range from 2 to 50 megacycles are described. The measurements, made by substitution against resistances, show an increase of conductance with increasing frequency, with an apparent resonance at 35·5 megacycles. Ionisation increases capacitance. Increase of voltage causes a current which is not uniformly linear, but has either one or two intervals of constant current; only at low voltages, where the current is linear, may the conductance justifiably be measured. It is suggested that at low frequencies only free electrons pass current; at high frequencies electrons bound to negative ions predominate. The apparent resonance is ascribed to a small number of very loosely bound electrons. W. H. W.

3852. Frequency and Striation Width of Moving Striations in the Positive Column of Rare Gases. W. Pupp. *Zeits. f. techn. Physik*, 15. 7. *pp.* 257–262, 1934.—The experimental results of various workers on moving striations in the positive column of discharges in He, Ne, Kr and A are examined and without going into the question of the mechanism of moving striations, certain regularities in their frequency and striation width characteristics are noted and exhibited for the four gases mentioned in a series of curves. A. W.

3853. Electron Affinities of the Light Elements. G. Glockler. *Phys. Rev.* 46. *pp.* 111–114, *July* 15, 1934.—The electron affinities of the light elements have been estimated by an empirical method of extrapolation. The ionisation potentials (I) of isoelectronic systems are considered to be parabolic functions of the atomic number (Z). The Moseley curves $I^{\frac{1}{2}} : Z$ of the first ionisation potential of the electronic systems containing from one to eighteen electrons have been completed. They are nearly straight lines except in their lower extremities where they show a bending towards the axis of atomic number Z. Wherever a check was possible it was found that the estimated electron affinities agree with experiment or with other calculation as obtained from wave mechanics or from thermochemical considerations by means of a Born-Haber cycle. The estimated electron affinities (in electron-volts) are: H (+0·7), He (−0·5), Li (+0·3), Be (−0·6), B (+0·1), C (+1·37), N (+0·04), O (+3·8), F (+3·9), Ne (−1·20), Na (+0·1), Mg (−0·9), Al (−0·2), Si (+0·6), P (+0·2), S (+2·1), Cl (+3·7), A (−1·0), Ni (+0·3), Cu (+1·2), Ag (+1·0), Hg (+1·8). AUTHOR.

3854. Lowest Excitation Potentials of the Nitrogen Molecule. H. Maier-Leibnitz and H. Sponer. *Zeits. f. Physik*, 89. 7–8. *pp.* 431–436, *June* 6, 1934.—By electron impact measurements a lowest critical potential is found for nitrogen at 6·7 volts. Energy losses also occur at 7·2 and 8·0 volts. These results are discussed along with those obtained in earlier electron impact investigations, and are found to be in good agreement with the position of the triplet terms of nitrogen recently put forward by Herzberg and Sponer. L. A. W.

3855. Excitation and Ionisation of Mercury Atoms in Noble Gas-Mercury Columns. F. M. Penning. *Physica*, 1. *pp.* 763–769, *July*, 1934. *English Abstract.*—From spectrograms of positive columns in Ne+Hg, 90 % Ne+10 % A, 90 % Ne+10 % A+Hg, 90 % Ne+10 % Kr+Hg (pressure 10 mm., dia. of tube 1½ cm., current 25 mA, tube in water) it is concluded that at 19° C. the positive ions are mainly Hg^+, formed by direct electron collision, whereas at 0° C. for the building of the ions excitation of the noble gas atoms is necessary. The difference in colour between Ne-Hg and Ne-A-Hg at 0° C. is due to the excitation of the Ne in Ne-Hg ; the intensity of the Hg line 5461 Å being the same in both cases when 10 %. The intensity variation of the line 5461 Å as a function of the distance to the kathode, being roughly proportional to the partial pressure of the mercury in the tube, was determined for the case that all the liquid mercury was concentrated at the kathode side of the tube (influence of the cataphoresis). AUTHOR.

3856. Efficiencies of Ionisation of Helium and Mercury by Electron Impact at High Voltages. J. W. Liska. *Phys. Rev.* 46. *pp.* 169–176, *Aug.* 1, 1934.—An apparatus which is designed to measure relative efficiencies of ionisation at high voltages is described. Measurements on He and Hg vapour are reduced to absolute values by comparison with the data of Smith. The results are given as a function of electron velocities up to 11 kV. The experimental data are compared with theoretical solutions based on classical and quantum mechanics. It is shown that the classical solutions agree fairly well with experiment in form but not in absolute magnitude. The quantum-mechanical solutions agree with experiment over a much larger range of velocities than do the classical solutions. Approximate values for certain constants which appear in the quantum-mechanical solutions yield absolute values for the efficiency of ionisation which agree with experiment within a few per cent. In both classical and quantum-mechanical solutions, the agreement is good only for electron velocities very much greater than the first ionisation potential of the atom. AUTHOR.

3857. Excitation of Band Systems by Electron Impact. G. O. Langstroth. *Roy. Soc., Proc.* 146. *pp.* 166–177, *Aug.* 1, 1934.—A theory of direct excitation by electron impact for band systems of symmetric diatomic molecules is given. It permits the calculation of the complete relative intensities of bands of a system. Measurements were made of the relative intensities of the 0 → 2, 1 → 3, and 2 → 4 bands of the second positive nitrogen system excited by electrons, with accelerating potentials between 14 and 160 volts, and of the 0 → 1 and 1 → 2 bands of the negative nitrogen system with accelerating potentials between 21 and 50 volts. The band intensity ratios are constant with accelerating potentials of more than 30 volts, but in the second positive system there is a dependence on voltage below this value. In the former voltage region the calculated and observed complete intensities agree surprisingly well, although the relative emission probabilities alone are quite different in sense from the observed intensities. The optical excitation functions for the second positive bands are of the usual form for triplet states, and those for the negative bands are of the form found by Lindh [see Abstract 1907 (1931)]. The complete intensities estimated graphically from the potential curves are in the right order, but the excitation and emission probabilities differ from those predicted by wave mechanics. AUTHOR.

3858. Proton Production in the Low-Voltage Arc. E. S. Lamar and O. Luhr. *Phys. Rev.* 46. *pp.* 87–91, *July* 15, 1934.—A tube has been designed with the object of obtaining large proton currents in a beam.

Ions are drawn out of the arc through a hemispherical grid inserted in the cylindrical electrode. Part of the resulting converging beam passes through a hole in a second electrode which separates the arc chamber from a region maintained at a lower pressure by differential pumping. Total currents of over 0·5 mA. at current densities of about 8·0 mA. per cm.^{2} were obtained on the low-pressure side. The ratio of proton current to total current was as high as 98 % with pressures in the discharge tube of 0·3 to 0·4 mm. In order to attain this percentage it was necessary to maintain certain minimum potentials on the cylinder and second electrode. At the same time the metal parts must be prevented from exceeding red heat since an adsorbed layer of hydrogen on the walls is necessary to prevent recombination of atomic hydrogen there. The proton currents obtainable are limited by the speed of the differential pumping and the degree of vacuum desired. The observed pressure ratios were improved by a factor of two when the arc was in operation owing to the increased temperature of the gas streaming through the hole. AUTHORS.

3859. Ionic- and Electro-Optical Cylindrical Lenses. R. Herzog. *Zeits. f. Physik*, 89. 7–8. *pp.* 447–474, *June* 16, 1934.—The orbits of charged particles in a combination of a radial electric and perpendicular homogeneous magnetic field are investigated for arbitrary initial conditions of the particles. It is shown that particles leaving any particular point are focussed to a point by the combination of fields. The focussing formulæ are the same as in the optics of cylindrical lenses. The positions of the cardinal points of the electrical lens system are calculated and the results of the theory are applied to various special cases, in particular to the mass spectrographs of Aston, Bainbridge and Dempster, and Bartky and Dempster. [See following Abstract.] J. E. K.

3860. New Mass Spectrograph. J. Mattauch and R. Herzog. *Zeits. f. Physik*, 89. 11–12. *pp.* 786–795, *July* 13, 1934.—The problems encountered in the design of an accurate mass spectrograph are briefly discussed. The design of such an instrument embodying the focussing systems of the spectrographs of Aston and Dempster is considered theoretically. A combination of two electron-optical cylindrical lenses [see preceding Abstract] (radial electrostatic field and homogeneous magnetic field) is used as an achromatic objective to form a sharp image of a narrow stream of canal rays of different velocity on a photographic plate. The design of the pole pieces for the magnetic focussing system is worked out for two particular cases. A high intensity in the image plane is to be expected, together with a high sensitivity. The mass scale is simple and is easily calculable and the resolving power is constant along the plate. H. J. H. S.

3861. Potential Measurements in Electron Rays. W. Rollwagen. *Zeits. f. Physik*, 89. 7–8. *pp.* 395–411, *June* 16, 1934.—The conditions under which electron rays may be formed are investigated. The restriction of the change of potential within the electron ray is the necessary condition for keeping the electrons concentrated. All electrons whose radial components of velocity are less than that corresponding to this potential gradient remain in the ray. A potential tending to draw the ions towards the walls is formed. The magnitude of the potential gradient depends on the density of the electrons and ions in the plasma and on the potential of the walls. Other factors that enter into the formation and maintenance of selection rays are discussed in detail. H. L. B.

3862. Electrified Space Containing Material Particles. M. Pauthenier and Marguerite Moreau-Hanot. *Comptes Rendus*, 199. *pp*. 189–190, *July* 16, 1934.—Previous calculations of the electric field in a cylindrical ionisation chamber, have been modified by the assumption of the presence of a stream of air containing dust particles. An additional term, corresponding to the space-charge due to the particles, is introduced into the Poisson equation. It is shown that the passage of a stream of air containing material particles results in a drop in the current Δi; an increase of the potential on the electrodes ΔV_m is required to restore the original current. Δi and ΔV_m are calculable. If potential distribution curves are drawn for the cases with and without dust, it can be shown that, in spite of the decrease of the current, the field near the wall increases. J. E. R.

3863. Ionisation Chambers and Identification of Rays of Definite Short Range. G. Dieck. *Zeits. f. Physik*, 90. 1–2. *pp*. 71–111, *July* 24, 1934.—Ionisation chambers of various materials in the course of a very extensive statistical investigation were examined from three points of view: the natural content of the material of the chamber in radioactive substances, the cumulative infection, and finally the radiation supposed by H. Ziegert with small amounts of ions. A process is given for diminishing the external radioactive infection. The influence of the material (chambers of various kinds of copper and of gold) on the magnitude and number of the particles is established. Three new radiations with definite amounts of ions were identified, of which two are interpreted as α-rays with short range (1·5 and 0·9 cm.) and the third as H-radiation which is assumed to be produced by neutrons which are liberated by cosmic radiation from the surrounding screen. J. J. S.

See also Abstracts 3455, 3630, 3648, 3739, 3740, 3843, 3948.

CONDUCTION IN SOLIDS AND LIQUIDS.

3864. Method of Measuring Electrostatic Potential-Difference. H. Subra. *Comptes Rendus*, 199. *pp*. 124–126, *July* 9, 1934.—A condenser is charged to the unknown potential, which is then balanced by means of a potentiometer, using a differential thermionic voltmeter of high input resistance as detector of balance. The p.d. supplied by the potentiometer is then measured with a voltmeter. L. H.

3865. Amplification of Direct Currents. P. Donzelot and J. Divoux. *J. de Physique et le Radium*, 5. *pp*. 357–372, *July*, 1934.—The use of valve circuits for measurements of d.c. of less than 10^{-10} A is discussed. The current is passed through a high resistance connected between the grid and filament of a valve, the measurement being made in terms of the resulting change in anode current. The chief problems arising in the realisation of the method are the compensation of the normal anode current and the elimination of instability arising from battery fluctuations. A bridge circuit containing two valves is recommended; the author's final choice uses double-grid valves with indirectly-heated kathodes. The importance of stabilising the grid potentials is particularly stressed, and a potentiometer device is described by which the grid and kathode potentials are regulated from one battery, so that by working the valves at appropriate points on their characteristics the circuit can be made self-compensating. Screening and insulation difficulties are discussed, the authors concluding that with the arrangement described a current as small as 10^{-14} ampere can be measured. N. F. A.

3866. Stable D.C. Amplifier Using 7567A Valves. M. Distad and J. H. Williams. *Rev. Sci. Instruments,* 5. *pp.* 289–291, *Aug.,* 1934.—Two single-valve d.c. amplifiers with 7567A valves have been constructed which are extremely stable in operation. Following the design of DuBridge and Brown [see Abstract 5019 (1933)] a modified balanced bridge circuit is described wherein the drifts are not due to fluctuations in battery potentials or changes in filament emission. Data on the determination of circuit constants necessary for the elimination of drifts are given. Currents of 3×10^{-15} ampere give galvanometer deflections of 1 cm. and readings can be obtained every 15 sec. AUTHORS.

3867. Variations of the Resistance of a Metallic Conductor of Small Volume. J. Bernamont. *Comptes Rendus,* 198. *pp.* 2144–2146, *June* 18, 1934.—The variations of the resistance of a platinum wire of 1μ dia. towards currents of frequencies up to 8 kc. have been measured. The calculated value of n_0/θ, where n_0 is the average number of free electrons per c.c. and θ is the mean life of the free electrons, is $1 \cdot 37 \times 10^{29}$ c.g.s. units. H. F. G.

3868. Influence of Pressure upon the Electrical Resistance of a Rodlet of Impure Zirconium Oxide in Air. J. Basset. *Comptes Rendus,* 199. *pp.* 38–41, *July* 2, 1934.—The rodlets employed contained 80 % oxide of zirconium and 10 % respectively of the oxides of thorium and yttrium, and an apparatus previously described [see Abstract 874 (1933)] has been used for the determination of electrical conductivity at different pressures. It is established that the electrical resistance increases with pressure, *e.g.,* in air, where at atmospheric pressure the resistance is 4500 ohms, it exceeds 10^6 ohms under 4000 kg./cm.^{2} The author has also found that whereas a voltage of 60 volts is sufficient to cause illumination of a rod at 800° under atmospheric pressure, 600 volts are insufficient at 200 kg./cm.^{2} The influence of impurities in the oxides employed is considerable. H. H. Ho.

3869. Second Effect of Electric Charge on the Conductivity of a Metallic Film. M. Pierucci. *N. Cimento,* 11. *pp.* 277–287, *May,* 1934. Besides the first effect of the change of conductivity of a metallic film due to an electric charge [see Abstracts 2957 and 3383 (1932)] the author has observed under certain conditions a second effect in a tungsten film much greater than the first, and consisting in an increase of conductivity produced by a positive charge or a negative charge. The magnitude depends on the previous electrostatic treatment of the film. After many thousands of repeated charges and discharges of the film the effect was 3000 times greater than the first effect. With a potential of 3500 volts and temperature — 82°·5 C. there was an increased conductivity of about one per cent. There exists a critical potential below which the effect does not appear and above which it acquires suddenly a notable value. The second effect is in magnitude and sign independent of the sign of the charge. J. J. S.

3870. Conductivity of Thin Metallic Films in an Electrostatic Field. R. Deaglio. *N. Cimento,* 11. *pp.* 288–295, *May,* 1934.—Thin metallic films of gold of platinum and of tungsten on glass or quartz obtained by kathodic projection and by thermic projection exhibited conductivity strongly variable in a reversible way with the electrostatic charge. The effect depends on the sign of the field only with films obtained by kathodic projection. Variations of resistance up to 40 % were observed for fields of the order of 5000 volts/cm. close to the film. With regard to the relation to the sign of the field the effect differs from that described by Perkins and by Pierucci [see Abstract 2957 (1932)]. J. J. S.

3871. Anomalous Electrical Conductivity of Thin Metals. H. Murmann. *Zeits. f. Physik,* 89. 7–8. *pp.* 426–430, *June* 16, 1934.—An optical method is described for determining the conductivity of thin metallic films without making use of contacts. The method is applied to silver films that have been thermally deposited. The same anomalies are found as occur when electrical methods are used. The author therefore rejects the view put forward by Wait and Steinberg according to which the low conductivity of metallic films is due to the small number of contacts between the individual groups of molecules. H. L. B.

3872. Electrical Conductivity and Phase Diagram of Binary Alloys. Li-Tl System. G. Grube and G. Schaufler. *Zeits. f. Elektrochem.* 40. *pp.* 593–600, *Aug.,* 1934.—The full range of Li-Tl alloys is investigated by the method of thermal analysis and by observation of the electrical resistance-temperature curves of the solid alloys. The results are embodied in a complete phase diagram for the system. The existence of the inter-metallic compounds LiTl, Li_2Tl, Li_5Tl_2, Li_3Tl, and Li_4Tl is proved. In the concentration region of the last four of these compounds the alloys have colours ranging from rose to violet. The compounds LiTl, Li_5Tl_2 and Li_3Tl melt without decomposition, the last two having melting points which are nearly the same (448° C. and 447° C. respectively). The upper temperature limit of existence of the other two compounds, which do not melt without decomposition, is about 381° C. L. A. W.

3873. Electrical Conductivity of Metals. N. F. Mott. *Phys. Soc., Proc.* 46. *pp.* 680–692, *Sept.* 1, 1934.—If the resistances of the pure metals are measured for the same amplitude of thermal oscillation of the atoms they show a marked periodic behaviour, being always two or three times greater for a monovalent element than for the divalent metal next to it in the periodic table. This fact is discussed on the basis of wave mechanics, and it is suggested that the periodic variation is due to a smaller effective number of free electrons in the divalent metals. Evidence in support of this view can be obtained from the optical constants of metals and from the increase of resistance due to foreign metals in solid solution. Bridgman's measurements of the change of resistance under pressure are discussed on the basis of wave mechanics. A quantitative theory is given of the behaviour under pressure of alloys and of pure metals at low temperatures, and a qualitative explanation is given of the abnormal metals Ca and Sr, whose resistance increases under pressure. AUTHOR.

3874. Conductivity of Chlorides, Iodides and Nitrates of Alkalis and Alkaline Earths in Water and Methyl, Ethyl and n-Propyl Alcohols. H. N. Desai, D. B. Naik and B. N. Desai. *Indian Journ. Phys.* 8. *pp.* 323–340, *April,* 1934.—Measurements of conductivity of chlorides, nitrates and iodides of alkali metals and alkaline earths over a large range of concentration have been made using water and methyl, ethyl and *n*-propyl alcohols as solvents. Λ_c. $\sqrt{C}$ curves in different solvents are not found to be straight lines showing that the Debye-Hückel-Onsager theory is not applicable for the concentrations tried in this investigation. For some salts in different solvents the value of Λ_o has also been calculated according to the interionic attraction theory. It is found that deviations of the calculated from the observed values increase with increasing concentration, the calculated values of Λ_e being even negative in some cases at higher concentrations. The curves obtained by plotting log Λ_e against log C for different salts in different solvents are found to be straight lines. A sudden change in the slope of log Λ_e, log C curves for different salts in water is observed at higher concentrations. AUTHORS.

3875. Conductivity of Concentrated Mixtures of Alkali Chlorides. P. van Rysselberghe and L. Nutting. *Am. Chem. Soc., J.* **56.** *pp.* **1435–1437,** *July,* **1934.**—A formula is obtained giving the equivalent conductivity of a mixture of alkali chlorides in terms of the conductivities and transport numbers of the pure salts at the same concentration as the total concentration of the mixture. Measured and calculated conductivities of mixtures of potassium and sodium chloride agree remarkably well up to as high a total concentration as 4 *M*. It is shown that at concentrations of the order of 0·1 *M*. the new formula and the old mixture rule give the same results. AUTHORS.

3876. Individual Behaviour of Organic Ions in very Dilute Aqueous Solution. J. Lange. *Zeits. f. Elektrochem.* **40.** **7b.** *pp.* **507–510**; *Disc.,* **510,** *July,* **1934.**—Measurements of freezing points and conductivity of solutions of tetraalkylammoniam salts show that the strong individual differences which are observed both in their osmotic and electrolytic behaviour in very dilute aqueous solutions arise neither from differences in the degree of dissociation of the salts nor from the varying sizes of their ions. It is therefore not legitimate, for strong electrolytes, to deduce the dissociation constant from the conductivity, or the ionic size from the thermodynamic behaviour, unless the basis of the theory of strong electrolytes is essentially extended. C. B. A.

See also Abstracts **3609, 3692, 3693, 3790, 3793, 3810, 3902, 3908.**

DIELECTRICS AND CAPACITANCE.

3877. Dielectric Properties of Cellulose. W. N. Stoops. *Am. Chem. Soc., J.* **56.** *pp.* **1480–1483,** *July,* **1934.**—Dielectric-constant and power-factor data on cellophane are given for a wide range of temperature and frequency. Anomalous dispersion and absorption are found and an hypothesis is advanced to explain the presence of orientation polarisation in terms of the structure of the material. Cellophane is found to have a dielectric constant nearly twice that of cellulose acetate. An explanation for this difference is suggested, based on their variation in chemical structure. AUTHOR.

3878. Dipole Moments of Vapours. Part I. L. G. Groves and S. Sugden. *Chem. Soc., J. pp.* **1094–1098,** *July,* **1934.**—The dielectric constants of vapours are measured at a known temperature and pressure by means of a resonance method which is described in detail. Dipole moments of the vapours of benzene, chlorobenzene (1·69), nitrobenzene (4·23) and benzonitrile (4·39) have been found. W. R. A.

3879. Dipole Moments of Methyl and Ethyl Halides. C. P. Smyth and K. B. McAlpine. *J. Chem. Phys.* **2.** *pp.* **499–502,** *Aug.,* 1934. —The dielectric constants of the vapours of the methyl and ethyl halides have been measured in order to obtain accurate values for their dipole moments. The increase in moment from the methyl to the ethyl halide accords with the previously advanced hypothesis of an inductive effect, but the change in the increase with change in the halogen involved points to the influence of an additional factor. The change in moment from compound to compound is compared with the change in the Raman frequency associated with the carbon-halogen bond. AUTHORS.

3880. Superficial Electric Moments in a Liquid. (Miss) N. Choucroun. *Comptes Rendus*, 199. *pp*. 36–38, *July* 2, 1934.—An improved apparatus is described [see Abstract 2118 (1933)] whereby electric moments of charged particles may be measured, and by its means the superficial electric moments of gamboge and mastic have been determined as a function of pH. The apparatus and its mode of action are utilised for the study of the electrification of certain bacteria, wherein it is shown that the electrification is not uniform along the surface of the rodlet, a heterogeneity which reveals a structure hitherto unobserved morphologically. Separation of bacillus groups has also been achieved and may be of biological significance. Heterogenous electrification has also been observed in certain yeasts, and for the same cell the electrification may vary in magnitude and even in sign in the course of time. The author opines that electrification revealed by the mobility of particles in the field may be a function of the vital rhythm of the cell and provide a means for its study. H. H. Ho.

3881. Applications of Dielectric Constants in Organic Chemistry. G. Devoto. *Zeits. f. Elektrochem.* 40. 7*b*. *pp*. 490–493, *July*, 1934. —In solution, the aliphatic amino-acids and the polypeptides are almost exclusively in the polar form (*e.g.*, $NH_3^+CH_2COO^-$) and the dipole moment increases regularly with the number of C-atoms between the poles. Similar regularities are recorded for monoaminodicarboxy- and diaminomonocarboxy-acids, and in a series of aromatic betaines. Such measurements make it possible to determine the distance between the polar groups in a molecule. C. B. A.

3882. Variation of Breakdown Voltage with Frequency. K. W. Wagner and A. Gemant. *Preuss. Akad. Wiss. Berlin, Ber. No.* 9. *pp*. 100–111, 1934.—On the assumption that breakdown is purely thermal, the relation between breakdown voltage and frequency is calculated from a knowledge of the variation of d.c. conductivity with temperature and of a.c. conductivity with temperature and frequency. The breakdown voltage is constant at low frequencies; then decreases with increasing frequency, the rate of decrease being greater the lower the temperature; and at high frequencies (of the order of $10^6 \sim$) is independent of temperature. The calculated results for glass and pertinax are in good agreement with experiment. E. R.

3883. Capacitance Measurement by the Rotating Commutator Method. A. V. R. Telang. *Indian Journ. Phys.* 8. *pp*. 365–375, *April*, 1934.—Discusses the apparent changes of capacitance of a condenser with a guard-ring, which result from a phase displacement of the two sets of brushes, which charge the condenser proper and guard-ring respectively. Shows that the component capacitances of the system may be determined by measurements with various phase displacements. L. H.

3884. Observation of the Internal Electric Field of Rochelle Salt by Means of X-Rays. H. Staub. *Helv. Phys. Acta*, 7. 5. *pp*. 480–482, 1934. *In German*.—Observations were made on the reflected intensity of X-ray interference over the whole temperature region of the Curie points (−20° C. and +24·8° C.) from −40° to +40° C. The intensity at the lower Curie point suddenly rises and at the upper again falls. Between the two Curie points there exists in Rochelle salt, as shown by the measurements made on different crystals, an internal electric field which causes an increase of the quasi-elastic connection of the dipoles, so that between the Curie points a modification is produced in the law of the change of intensity of X-ray interference with temperature [see Abstract 1305 (1934)]. J. J. S.

See also Abstracts 3692, 3693.

ELECTROCHEMISTRY.

3885. Purification of Manganese Dioxide for Dry Cells. H. Iida. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 364. [13 *pp*.], 1934. *English Abstract.*—Pyrolusite and other natural manganese dioxides generally contain compounds of iron and compounds of manganous manganese. When the finely ground MnO_2 is treated with hot dilute acid, these impurities can be dissolved out, and removed by electrodialysis. The best method of electrodialysis is to use a.c. superposed crosswise upon d.c. The a.c. disturbs the impurities and they are moved by the d.c. The dry cell made with the treated MnO_2 has a longer life and a very low internal resistance. AUTHOR.

3886. Formation and Daniell Cells in Melts. G. Grube and E. A. Rau. *Zeits. f. Elektrochem.* 40. 7*a*. *pp*. 352–360, *July*, 1934.—e.m.f. measurements of a number of cells of the types $M|MCl_2|Cl_2$ and $M|MCl_2|M'Cl_2|M'$ are recorded, both with and without the melts surrounding the electrodes being separated from one another by glass diaphragms. In the case of the cells $Pb|PbCl_2|Cl_2$ and $Ag|AgCl|Cl_2$ the e.m.f. and the temperature coefficient are altered by interposition of the diaphragm, by an amount dependent upon the nature of the glass. The e.m.f. of the cell $Pb|PbCl_2|\text{glass}|AgCl|Ag$ is 0·158 volt at 628° C., as compared with 0·311 volt in absence of the glass. The e.m.f.-temperature relation is linear, the coefficient being negative for all the cells studied except $Cl_2|PbCl_2|\text{glass}|AgCl|Ag$. The Lorenz difference law is applicable to the cells with glass diaphragms. Cells in which the melt is a mixture of $PbCl_2$ and KCl (1 : 1 and 2 : 1 mol. ratios) have approximately linear temperature coefficients at high temperatures, but at lower temperatures the e.m.f. rises more rapidly; complexes appear to be formed in the melts. H. F. G.

3887. Electrolysis of Zinc and Cadmium Chlorides in Methyl Alcohol Solution. E. Guillermet. *Comptes Rendus*, 199. *pp*. 191–193, *July* 16, 1934.—With a 5 % solution of $ZnCl_2$ in MeOH, a Pt kathode and anode, and c.d. 1·3–5 A/dcm.^{2} pure Zn, adhering well to the Pt, was deposited, but with c.d. 3–5 A/dcm.^{2} arborescent growths formed on the angles of the kathode, and with 1 A/dcm.^{2} the deposit contained some oxychloride unless the current was continued for at least 4 hr. or the solution was acid. The yield (55–90 %) decreases with time and increased c.d., but with a zinc anode is 95 %. It is increased by a diaphragm, decreased by addition of acid. The strongest solution obtainable with $CdCl_2$ contains 0·7–0·9 %, with this and c.d. 0·5–3 A/dcm.^{2} only black spongy deposits containing white patches (of apparently an oxychloride containing MeOH) were obtainable with either a Pt or Cd anode. [See Abstract 799 (1934).] C. A. S.

3888. Application of the Laws of Chemical Kinetics to Electrolysis. S. A. Pletenew and W. N. Rosow. *Zeits. f. Elektrochem.* 40. *pp*. 600–604, *Aug*., 1934.—An account is given of velocity measurements which show that the fundamental equations of chemical kinetics are applicable to the solution of Cu in solutions of $Fe_2(SO_4)_3$ or $CuCl_2$ and also to the anodic oxidation of $FeSO_4$. The explanation of the decrease in the rate of solution of Cu in $Fe_2(SO_4)_3$ solution due to the presence of Al salts is shown to lie in the increase of viscosity of the solution. It is pointed out that a number of electrochemical processes associated with the electrolysis of Cu solutions can be calculated by application of the laws of chemical kinetics. L. A. W.

3889. New Method for Determination of Transport Numbers. G. S. Hartley, E. Drew and B. Collie. *Faraday Soc., Trans.* 30. *pp.* 648–662, *Aug.*, 1934.—The method is a new application of the moving boundary theory, which enables the transport number of the " indicator " radical to be measured. Use is made of the Kohlrausch relationship between the concentrations of the leading and indicator solutions, the apparatus being designed to measure the latter. The method is applicable, which the ordinary moving boundary method is not, to the measurement of the transport number of radicals of very low mobility. It has been tested by measurements with electrolytes whose transport numbers are known, and is shown to be capable of a high degree of accuracy. AUTHORS.

3890. Dependence of Resistance of Electrodes during Electrolysis on Pressure. R. A. J. Bosschart. *Physica,* 1. *pp.* 715–724, *June,* 1934. *In German.*—Measurements were made with d.c. of the decomposition potentials of solutions of NaCl. The electrode used were C and Pt. The measurements were carried out at high pressures and at high current densities. At current densities of 0·1 to 8 amperes per cm.^{2}, the current-voltage curve was straight, and not a logarithmic curve as given by Tafel and Glasstone. The resistance was found to decrease as the pressure increased. The decrease was independent of concentration, current density and temperature. F. J. B.

3891. Electrode Potentials of Tl-Bi Alloys. A. Ölander. *Zeits. f. phys. Chem.* 169. *Abt.A.* 3–4. *pp.* 260–268, 1934.—The electrode potentials of solid Tl-Bi alloys were measured at moderately high temperatures. The potential of the combination $Tl_{solid}/(Na, K, Tl)O\cdot COCH_3/$ Tl-Bi_{solid} in which twelve alloy electrodes were employed was measured between 245°–295° C. The potential of the combination $Tl_{solid}/Tl\cdot O\cdot CO\cdot CH_3/$Tl-$Bi_{solid}$ and its temperature coefficients were measured for 32 alloys at temperatures between 120° and 165° C. The various results were employed to revise the equilibrium diagram. The range of existence of two intermediate phases was examined and were found to possess unordered distribution of atoms. F. J. B.

3892. Standard Potential of the Bromine Electrode. G. Jones and S. Baeckström. *Am. Chem. Soc., J.* 56. *pp.* 1524–1528, *July,* 1934.—The e.m.f. of galvanic cells of the type Pt(+), KBr(*c*) + Br_2, KBr(*c*), AgBr, Ag(−) were measured at 25°. The KBr concentration varied from 0·01 to 1·0 *N* and the Br concentration from 0·9 to 10·3 % of saturation. E^0_{298} for this cell was found to be − 0·9940 volt, which gives for the free energy of formation of AgBr $\Delta F_{298} = -22{,}935$ cal. The Ag-AgBr electrode was compared with the HgCl and Ag-AgCl electrodes. The results were

Ag(−), AgBr, 0·1 *N* KBr ‖ 0·1 *N* KCl, HgCl Hg(+) $E^0_{298} = 0\cdot1966$ volt
Ag(−), AgBr, 0·1 *N* KBr ‖ 0·1 *N* KCl, AgCl Ag(+) $E^0_{298} = 0\cdot1511$ volt

These results were combined with recent determinations of the standard electrode potential of the Ag-AgCl electrode to give the value − 1·0652 volt for the standard electrode potential of liquid bromine and the value − 1·0852 volt for the standard electrode potential of bromine at unit activity. AUTHORS.

3893. Electrode Potential of Nickel. L. Colombier. *Comptes Rendus,* 199. *pp.* 273–275, *July* 23, 1934.—The variations found by various investigators [see Abstract 2327 (1929)] in the electrolytic potential of nickel are due to adsorbed gas (O and/or H). This can only be removed by first heating the metal in a current of H at 500° for two hours, and then for one hour at 500° *in vacuo.* After such treatment concordant results are obtained, giving the figure − 0·227 ± 0·002 volt at 20°. C. A. S.

3894. Theory of Passivity. W. J. Müller and E. Löw. *Zeits. f. Elektrochem.* 40. *pp.* 570–582, *Aug.,* 1934.—After being rendered passive in sulphuric acid, iron enters into solution in the divalent form at potentials up to 0·7 volt; at potentials between 0·8 and 1·4 volt tervalent iron enters the solution, whilst at still higher potentials oxygen is evolved at the anode. At and below 0·5 volt the primary crystalline doubly-refracting film changes into a feebly polarising white film which appears to consist of basic salt, whereas at higher potentials it becomes converted into a completely transparent oxide layer; the period required for this latter transformation is governed by the fact that the solution at the anode is saturated with ferrous sulphate, and the film can react only as the ferrous sulphate concentration is reduced either by dissolution of iron to yield ferric sulphate or by diffusion of water. At relatively high potentials, in 4*N*-sulphuric acid, the evolution of oxygen does not begin immediately the transformation of the film has occurred, the current being maintained for about ½ min. by the tervalent dissolution of the iron. The lowest voltage at which evolution of oxygen has been observed is 1·4. The results afford further support for the authors' views on passivity. H. F. G.

See also Abstracts 3461, 3553, 3932.

ELECTRONS, POSITRONS AND PROTONS.

3895. Annihilation of Positrons. F. Joliot. *J. de Physique et le Radium,* 5. *pp.* 299–303, *July,* 1934.—Experiments were carried out with a view of verifying the anticipations of Dirac's theory on the annihilation of positrons. The absorption of a bundle of these particles in Pb or Al gives rise to an emission of photons whose energy was found equal to 485 ± 60 kVe. Experiment shows that the number of photons corresponding to the dematerialisation of a positron is in the neighbourhood of 2. The results obtained confirm the forecasts of the theory. [See Abstract 1318 (1934).] J. J. S.

3896. Materialisation of Hydrogen from Ether. V. Posejpal. *Comptes Rendus,* 199. *pp.* 186–188, *July* 16, 1934.—In previous papers [see Abstract 1317 (1934)] the author shows that his theory of the ether involves the materialisation of atoms at high potentials. His experiments appear to show the formation of H in this manner. The possible effect of residual H in the evacuated vessel is now tested by introducing very small quantities of pure H; the author finds the effect unaltered and concludes that residual H, from whatever source, plays a negligible part. By analysing the gas coming from the auxiliary pump first with a length of Pt wire arranged within the evacuated vessel to absorb the H, and secondly as described in the previous paper, the author finds the rate of production of H to be double that under electrolysis. This agrees with his theory, which involves the formation of two H atoms by the passage of unit charge. T. L. M.

3897. Classical Theory of the Spinning Electron. H. A. Kramers. *Physica,* 1. *pp.* 825–828, *July,* 1934. *In English.*—The ratio *e/mc* of magnetic moment and angular momentum of the electronic spin can be derived classically without referring to a detailed classical model of the constitution of the electron. The theory leads to a simple classical derivation of the Thomas factor. AUTHOR.

3898. Magnetic Moment of the Proton. I. I. Rabi, J. M. B. Kellogg and J. R. Zacharias. *Phys. Rev.* 46. *pp.* 157–163, *Aug.* 1, 1934.—The magnetic moment of the proton has been measured by a method depending on the deflection of a beam of neutral H atoms in weak magnetic fields of sufficient inhomogeneity. When the field is of such magnitude that the nuclear spin is only partially decoupled from the electron spin the nuclear moment can be evaluated by measuring the atomic magnetic moments of the magnetic levels. Detection was effected on a molybdenum oxide coated plate and the results evaluated by the measurement of the widths and separation of the traces produced. A novel method of great convenience and simplicity for producing the proper magnetic field is described. The value of the proton moment obtained is 3·25 ± 10 %. AUTHORS.

3899. Magnetic Moment of the Deuton. I. I. Rabi, J. M. B. Kellogg and J. R. Zacharias. *Phys. Rev.* 46. *pp.* 163–165, *Aug.* 1, 1934. —The magnetic moment of the deuton was measured by the deflection of a beam of neutral deuterium atoms. The magnetic moment of the deuton is found to be 0·75 ± 0·2 nuclear units. AUTHORS.

3900. Loss of Energy of Fast Electrons by Radiation. L. Landau. *Phys. Zeits. d. Sowjetunion,* 5. 5. *pp.* 761–764, 1934. *In German.*—A simple method of deducing Heitler's formula [see Abstract 4477 (1933)] for the radiation losses which occur during the stopping of fast electrons is given. F. C. C.

3901. Surface Lattice Interference with an Electron Beam Incident on a Galena Crystal. S. v. Friesen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 24*B. No.* 8. *pp.* 1–4, 1934. *In German.*—The difference in the interference patterns produced when an electron beam is incident upon the natural and the etched surfaces respectively of a galena crystal is shown in photographs which are reproduced. The strongest line on the original photograph for the etched surface is found to be double. F. C. C.

3902. Electron Movement in Confined Crystal Lattices. S. Rijanow. *Zeits. f. Physik,* 89. 11–12. *pp.* 806–819, *July* 13, 1934.— The problem of deriving the energy spectrum and work function of the electrons in a limited thin metallic layer is considered. It is shown that a limited layer may be considered as an infinitely extended layer with an altered energy level and in addition there is present a surface energy level in which the electron density is periodic and which diminishes with the distance from the surface. H. J. H. S.

3903. Calculation of Intrinsic Potential in a Crystal Lattice from the Deviations from Bragg's Law. Part II. W. E. Laschkarew. *Zeits. f. Physik,* 89. 11–12. *pp.* 820–825, *July* 13, 1934.—A method already described [see Abstract 1323 (1934)] is applied to the experimental results of Yamaguti to calculate approximately the potential in a MoS_2 crystal lattice. Use is made of the relation between the intrinsic potential and the order of reflection. The method is limited, for it depends on the number of orders of reflection obtainable (in the case of MoS_2 this is large). Some calculations are also given for the case of graphite. H. J. H. S.

3904. Correlation Between Variation of Secondary Electron Emission and Atomic Number. P. L. Copeland. *Phys. Rev.* 46. *pp.* 167–168, *Aug.* 1, 1934.—The relative mean variation of the secondary emission as a function of the energy of the primary electrons is found to correlate with the atomic number of the elements bombarded. The evidence suggests that the secondary emission from a given element when bombarded by electrons of high energy may be represented to a first approximation by an equation of the form $R=k/E_p^s$, where R is the ratio of the total secondary current to the incident current and E_p is the energy of the incident beam. *k* and *s* are constants characterising a given curve, and evidence is presented to show that *s* decreases as the atomic number increases. The significance of the correlation is very briefly discussed.
AUTHOR.

3905. Electron Scattering by Atomic Electrons. A. L. Hughes and R. C. Hergenrother. *Phys. Rev.* 46. *pp.* 180–186, *Aug.* 1, 1934.—The velocity distributions of electrons scattered by He atoms, at angles ranging from 10° to 60°, have been measured for electrons having energies of 800, 1000, and 1200 volts. The curves have a well-defined narrow maximum where the scattered electrons have the same velocity as the primary electrons, this being the well-known elastic scattering. In addition, for each angle of scattering, a single broad peak is superposed on the continuous distribution of velocities ranging from the maximum down to zero. This represents the inelastically scattered electrons. The position of each peak is such that the velocity corresponding to it is given approximately by $v=u \cos \theta$, where u is the velocity of the electron before impact and θ the angle of scattering. This is the formula for the velocity of an electron when scattered through θ, by a free electron initially at rest. The inference is that we may associate these inelastic peaks with collisions between the incident electrons and the atomic electrons when the binding energy is small in comparison with the energy transfers during the collision. Jauncey's theory of the breadth of the modified line in the Compton effect is discussed in relation to the breadth of the inelastic peak, on replacing the photon by the incident electron. AUTHORS.

3906. Scattering of Slow Electrons by Organic Molecules. Part I. Acetylene, Ethylene and Ethane. E. C. Childs and A. H. Woodcock. *Roy. Soc., Proc.* 146. *pp.* 199–205, *Aug.* 1, 1934.—Experiments have been carried out to measure the angular distributions of 4, 6, 8, 10, 12, 15, 20, 25, 30 and 40 volt electrons scattered elastically in acetylene, ethylene and ethane. The results are discussed in relation to the shapes of the molecular field contours and, at the higher voltages, to the symmetry of the atomic configurations. AUTHORS.

3907. Behaviour of Gases and Vapours towards Slow Alkali Ions. O. Schmidt. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 498–499, *July*, 1934.—The behaviour of the gases or vapours of Hg, X, Kr, A, Ne, He, H_2, N_2, O_2, CO, CO_2, CH_3Cl, CH_4, C_2H_4, C_2H_6, C_4H_8, C_4H_{10}, and NH_3 towards slow alkali ions, at a pressure of 3×10^{-3} mm., is investigated. Pure scattering without loss of energy is observed in Hg. The rare gases, in the order of decreasing atomic weight, cause increasing loss of energy of the K^+-ion. The exact reverse is observed in the hydrocarbons, where the loss of energy increases with increasing molecular weight. This is attributed to an absorption of internal energy, which is greater the less stable the molecule. The mono-olefines seem more stable than the paraffins and have a smaller cross-section. NH_3 is unstable to the collisions, but CH_3Cl seems extraordinarily stable, and, like CO and CO_2, has a small collision area. The result of a collision depends on the time during which the colliding particles are in contact, and this appears to depend, since the bombarding ion is the same in each case, on the distribution of charge in the bombarded particle. C. B. A.

See also Abstracts 3455, 3487, 3648, 3704, 3705, 3706, 3712, 3936.

ELECTROSTATICS.

3908. Action of an External Electrical Field on Hydrogenated Metals. T. Franzini. *Accad. Lincei, Atti,* 19. *pp.* 584–588, *April* 22, 1934.—The resistance of the Pd wire used was 3·3280 ohms before hydrogenation, and 5·0495 ohms after electrolytic hydrogenation for 5 hours. This value remained practically constant for 7 days, even though the wire was kept in vacuum (10^{-4}–10^{-6} mm.) for part of the time. On application of a potential of 15 kV for 15 min. to an adjacent plate, in high vacuum, under conditions such that the gradient at the surface of the wire was 60,000 volts per cm., hydrogen was lost and the resistance fell to 4·62 ohms; on repetition of this treatment it fell further to 4·30 ohms. The conclusion is drawn that the applied field causes the loss of protons from the wire; this view is supported by calculation of the quantity of electricity which passed between the plate and wire, and by spectroscopic detection of the hydrogen which accumulated within the tube when the pump was not operating. H. F. G.

3909. Johnsen-Rahbek Effect. G. Déchêne. *Comptes Rendus,* 199. *pp.* 266–268, *July* 23, 1934.—The arrangement used consisted of a flat metal plate as one electrode, M, on which lay a piece of chalk (the semi-conductor) 9 mm. thick; its upper surface, 3·6 cm.^{2}, was polished and on it lay a second metal plate forming the other electrode, P, attached to one arm of a balance so that the force, F, by which it was attracted to the chalk could be determined. V being the p.d. between P and M, v that between P and the chalk surface, E the electric field, σ the surface electric density on P, and K the dielectric constant of the chalk, it is shown that $F=KE^2/8\pi=2\pi\sigma^2/K$; while the capacity of the contact$=\sigma/v$ per cm.^{2} of P. F, E, v, σ and C have been determined when V=160, 330, 500 and 645 volts. The difference V–v increases with V, as also do (v being constant) F, E, C and σ with increased conductivity of the semi-conductor. This method of explaining the effect also accounts for the difference in F according to the direction of the current. [See Abstract 3099 (1928).]

C. A. S.

See also Abstracts 3765, 3862, 3869, 3870.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3910. Theory of Thermomagnetic and Thermoelastic Phenomena. P. Chramov and L. Lwowa. *Zeits. f. Physik,* 89. 7–8. *pp.* 443–446, *June* 16, 1934.—The dependence of the e.m.f. of Ni–Cu and Fe–Cu thermoelements on the magnetisation and the longitudinal tension (Thomson-Nernst effect) were investigated. Akulov has established theoretically that the change of the e.m.f. of the thermoelement is proportional to the square of the magnetisation (for small degrees of magnetisation), and is proportional to the first power of the elastic force which acts on the thermoelement, and further that the ratio of the second coefficient of proportionality to the first is equal to the product of the magnetic initial susceptibility and the magnetostriction of the crystal (on magnetisation to saturation along the axis of easier magnetisation). These rules were tested experimentally and shown to hold good, the third relation applying only to magnetically very weak substances. The thermomagnetic and the thermoelectric effects are brought about by the anisotropy of the crystal, and Akulov's law of anisotropy holds also for the thermomagnetic phenomena. [See Abstract 1725 (1934).] J. J. S.

MAGNETISM AND ELECTROMAGNETISM.

3911. Conformable-Invariant Form of the Maxwell Equations. J. A. Schouten and J. Haantjes. *Physica,* 1. *pp.* 869–872, *July,* 1934. *In German.*—It is shown that the Maxwell equations and the electromagnetic impulse-energy equations can be written in conformable-invariant form. The electromagnetic theory can in this way be built up on the basis of a conformable geometry; it needs neither a metric nor a parallelism. Metric and parallelism originate accordingly in the material phenomena not in the electromagnetic. J. J. S.

3912. Unsymmetrical Hysteresis Loop. S. S. Sidhu. *Indian Journ. Phys.* 8. *pp.* 451–467, *June,* 1934.—This article describes an investigation to determine the magnetic properties of different grades of Si sheet steel and 50 % Ni steel when symmetrically and unsymmetrically magnetised; from the results a formula has been derived which should be of value in designing electrical apparatus used in circuits where a.c. and d.c. are superposed. AUTHOR.

3913. Reversible Processes and Magnetic After-Effect. E. A. Neumann. *Zeits. f. Physik,* 89. 5–6. *pp.* 308–316, *June* 2, 1934.—A distinction is drawn between a reversible or loss-free magnetic change and one which may take place equally well in either direction. The second of these cases is excluded if a " Jordan loss term " is present which is referable to hysteresis. So far, all observations have referred this term to magnetic after-effect. [See also Abstract 836 (1934)]. G. E. A.

3914. Demagnetisation Factor for Thin Circular Sheets. J. L. Snoek. *Physica,* 1. *pp.* 649–654, *June,* 1934. *In German.*—The demagnetising factor, N, for thin cylinders of small dimension ratio, magnetised perpendicular to the axis of rotation, is calculated by considering the cylinder as an ellipsoid of revolution. A linear relation is found between N and the dimension ratio, *viz.*, $N = 14 \cdot 2\ d/D$, for ratios less than $0 \cdot 01$. This relation is verified experimentally by a torsional method for cylinders 13 mm. in diameter and of thickness 50 to 120 μ. H. J. H. S.

3915. Non-Orthogonal Wave Functions and Ferromagnetism. D. R. Inglis. *Phys. Rev.* 45. *pp.* 135–138, *July* 15, 1934.—Close consideration of the influence of non-orthogonality of the electronic wave functions in a crystal shows that because of the large number of terms arising from the possible permutations of electrons, the usual procedure involving the neglect of most of the terms arising from this lack of orthogonality may be seriously in error. The dependence of the relative energies of the states of low and high multiplicity on this factor is discussed and exemplified in the cases of some simple molecular models. AUTHOR.

3916. Magnetic Properties of Iron-Cobalt Single Crystals. J. W. Shih. *Phys. Rev.* 46. *pp.* 139–142, *July* 15, 1934.—Single crystals of Fe-Co alloys were obtained from recrystallised pure ingots and their components of magnetisation parallel to magnetic forces applied along axes of symmetry were measured by a pendulum magnetometer. It was found that the direction for easiest magnetisation changes from $< 100 >$ to $< 111 >$ as the amount of cobalt in the alloy increases. This transition occurs at about 42 % Co. This result contradicts Fowler and Powell's view concerning the dependence of direction of magnetisation upon crystal structure. Some magnetic properties of polycrystalline alloys are explained. Akulov's theory for the magnetisation curve of a single crystal was applied to a specimen with 70 % Co. The agreement between theory and experiment is good in this case. AUTHOR.

3917. Dependence on Frequency of the Permeability of Iron, Nickel and Cobalt. R. Sänger. *Helv. Phys. Acta,* 7. 5. *pp.* 478–480, 1934. *In German.*—A falling-off of the permeability is observed at very high frequencies. Whether the observed decrease of the permeability at wave-lengths of 100 to 10 cm. is to be referred to a critical time (partition shifting process), or to a critical length (exhibition of skin effect) cannot be decided with the observation material existing at present. It would be interesting, in view of this, to extend the researches on Fe, Ni and Co to wires which are under different mechanical tension. J. J. S.

3918. Ideal Magnetisation and Coercive Force. S. Procopiu. *Comptes Rendus,* 199. *pp.* 126–127, *July* 9, 1934.—Equations previously obtained [see Abstract 3034 (1934)] show that ideal permeability should be identical with ordinary permeability when the coercive force is zero. The close agreement of the two values of permeability for a single crystal of iron is therefore a consequence of the smallness of its coercive force. L. H.

3919. Curie Points and Atomic Moments of Fe-Pt Alloys. M. Fallot. *Comptes Rendus,* 199. *pp.* 128–129, *July* 9, 1934.—Gives curves of Curie points and atomic moments for alloys with atomic percentages of Pt varying from 0 to 25. When the atomic % of Pt exceeds 3·7 the transformation from the α- to the γ-form with rising temperature, occurs at a higher temperature than the reverse change with falling temperatures. The addition of Pt to Fe causes an increase of the mean atomic moment. No other non-ferromagnetic element has been known to produce such an effect. L. H.

3920. Magnetic Anisotropy and Cold Working. A. Schigadlo and S. Sidelnikov. *Phys. Zeits. d. Sowjetunion,* 5. 5. *pp.* 714–721, 1934. *In German.*—Akulov's method of magnetic analysis [see Abstract 599 (1932)] is used to determine the crystalline texture of a rolled ferromagnetic specimen. When the anisotropy thus determined is taken into account, the theoretical hysteresis curve is found to agree closely with that found experimentally. J. P. A.

3921. Physical Investigations on New Magnetic Materials. M. Kersten. *Zeits. f. techn. Physik,* 15. 7. *pp.* 249–257, 1934.—These materials are compressed mixtures of magnetic powders with substances which insulate electrically and magnetically. They have been named isoperms, and their outstanding property is a very small remanence which amounts to a few hundredths of the saturation induction. This abnormally small remanence occurs in certain alloys after cold rolling, and is traced to a heterogeneous separation resulting from the cold working, and is due to the arrangement of the material in a magnetically " most favourable position " at right angles to the plane of rolling. G. E. A.

3922. Diamagnetism of Nitrobenzene at Different Temperatures. S. R. Rao and S. Sriraman. *Indian Journ. Phys.* 8. *pp.* 315–322, *April*, 1934.—The diamagnetic susceptibility of nitrobenzene has been determined at different temperatures ranging from 30° to about 110° C. by a modified Quincke's method. The specific susceptibility is found to decrease as the temperature is increased from 30° C., a flat minimum is attained at about 75° C. and then the value shows a gradual rise. Attention is drawn to the similarity in behaviour of the magnetic property with the variation of the optical anisotropy of nitrobenzene with temperature. Molecular association is mentioned as the probable cause of the anomalous behaviour. AUTHORS.

3923. Diamagnetism of Organic Liquid Mixtures. S. R. Rao. *Indian Journ. Phys.* 8. *pp.* 483–501, *June*, 1934.—The magnetic susceptibilities of some organic liquid mixtures have been examined by a new method. It is found that there are no departures from the additive law of mixtures. The cases of acetone-chloroform and acetone-nitrobenzene mixtures are examined critically and strong evidence is put forward to show that association does not produce any change in the specific diamagnetic susceptibility. [See Abstract 2574 (1932).] AUTHOR.

3924. Principal Magnetic Susceptibilities of Graphite. B. C. Guha and B. P. Roy. *Indian Journ. Phys.* 8. *pp.* 345–352, *April*, 1934. —Extensive measurements have been made on the principal diamagnetic susceptibilities of some good crystals of Ceylon graphite. The susceptibilities along the hexagonal axis of the crystal and along perpendicular directions (*i.e.*, in the basal plane) are found to be $22{\cdot}8 \times 10^{-6}$ and $-0{\cdot}4 \times 10^{-6}$ c.g.s. e.m.u. respectively, per gm. The significance of the large anisotropy is discussed. AUTHORS.

3925. Magnetic Susceptibility of Copper under Elastic Stress. Y. Watase. *Tohoku Univ., Sci. Reports*, 23. *pp.* 208–212, *May*, 1934. *In English.*—A copper tube was subjected to a strong transverse magnetic field (*a*) when containing compressed hydrogen, and (*b*) when the gas was removed. The susceptibility χ, calculated by a weighing method, has a normal value $-0{\cdot}083 \times 10^{-6}$, and increases to about $-0{\cdot}088 \times 10^{-6}$ as the result of elastic stress caused by hydrogen under 6 atmospheres pressure. G. E. A.

3926. Magnetic Susceptibility of Gases and Vapours. R. Jaanus and J. Schur. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. *pp.* 467–469, *June* 11, 1934. *In English.*—A new method based upon that of Lehrer was employed for the measurement of the magnetic susceptibility. The gas under investigation is enclosed in a tube forming a closed rectangle which is placed in a perpendicular plane between the plane poles of an electromagnet so that the middle of its upper horizontal part may lie in the homogeneous maximum of the magnetic field. By means of furnaces on both sides of this region uniform temperatures are maintained. Measurements of the susceptibility of CO_2 gave results in agreement with those obtained by previous investigators. J. J. S.

3927. Temperature and Diamagnetism. Part I. Susceptibilities of Some Aromatic Liquids. S. S. Bhatnagar, M. B. Nevgi and M. L. Khanna. *Zeits. f. Physik*, 89. 7–8. *pp.* 506–512, *June* 16, 1934. —The magnetic susceptibilities of various aromatic liquids were measured at 0° C. and 70° C. and the results are given in tables. From these it appears that the diamagnetism of aromatic liquids is in general independent of temperature. The gaseous space above the liquid meniscus must be partially filled with the vapour of the liquid concerned. J. J. S.

3928. Influence of Temperature and Constitution on the Diamagnetism of Organic Compounds. B. Cabrera and H. Fahlenbrach. *Zeits. f. Physik*, 89. 11–12. *pp.* 682–700, *July* 13, 1934.—The susceptibilities of cetyl alcohol, hexane, benzene, acetic acid, *o*- and *p*-cresol, *o*-, *m*-, and *p*-nitrotoluene, *p*-chlorophenol and a number of glasses have been investigated between −50° C. and 140° C. The susceptibilities of *iso*-amyl alcohol and sugar carbon at room-temperature have also been measured. Primary alcohols show the same dependence on temperature as water. All other organic compounds appear to be independent of temperature. All show an increased suceptibility on transformation from solid to liquid, the extent of the increase being related to the dipole moment of the substance. [See Abstract 369 (1934).] W. R. A.

3929. Diamagnetism of Ions. L. Abonnenc. *Comptes Rendus*, 198. *pp.* 2237–2239, *June* 25, 1934.—Using the method of falling drops results have been obtained for aqueous solutions the chlorides of Li, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, Be and La. Several fluorides, bromides and iodides have been examined also. Values for the kationic susceptibilities are obtained by subtracting established values for anionic susceptibilities from the experimentally obtained value for the aqueous solution of the salt. Weiss' equation for the effect of refraction is applied to correct the kationic susceptibilities and give the proper values for the free ion in each case except Be. KF has a molecular suceptibility of $24 \cdot 5 \times 10^{-6}$ and the values for F^- are $8 \cdot 2$ (in solution) and $7 \cdot 7$ (free) $\times 10^{-6}$. W. R. A.

3930. Paramagnetism. Part II. Origin of the Term Δ in Paramagnetic Salts. S. Datta. *Phil. Mag.* 17. *pp.* 1160–1168, *June*, 1934.—Van Vleck's theory of the origin of Δ is not sufficient to explain experimental results on Co and Ni salts in different solvents and different states of aggregation. Paramagnetic salts exist as undissociated molecules in solution and large values of Δ are attributed to some form of interchange interaction between electrons attached to the paramagnetic atom and its halogen neighbours. [For Part I see Abstract 1732 (1934).] W. R. A.

3931. Magnetic Properties of Rare Earth Salts. E. H. Williams. *Phys. Rev.* 45. *pp.* 133–134, *July* 15, 1934.—Measurements of the paramagnetic susceptibility of certain rare earth salts as a function of temperature yield the surprising result that the plot of the reciprocal of the susceptibility, $1/\chi$, against the absolute temperature, T, consists of a broken line. However, when very careful drying was made, the locus, in the case of $Gd_2(SO_4)_3 \cdot 8H_2O$, became a single straight line passing through the origin. The broken line phenomenon was observed for $GdCl_3$, $NdCl_3 \cdot 6H_2O$ and $Gd_2(SO_4)_3 \cdot 8H_2O$. AUTHOR.

3932. Magnetic Moment and Reaction Cross-Section by the Para-Hydrogen Transformation Method. H. Sachsse. *Zeits. f. Elektrochem.* 40. 7b. *pp.* 531–535, *July*, 1934.—The para-hydrogen transformation can be applied to the measurement of magnetic moments and collison areas. It is shown that B_2H_6 in the ground state is diamagnetic. An energy of 4500 cal. would be required in order to produce an excited paramagnetic state. (A para-hydrogen conversion measured between room-temperature and 100° is attributed to an atom-exchange reaction, with a heat of activation of 18,000 cal., steric factor 1/30). The transformation effected by paramagnetic ions in solution is independent of the nature of the anion, of the concentration, and (for aqueous and alcoholic solutions) of the solvent. Radii for the ions Cr^{3+}, Fe^{3+}, Cu^{++}, Ni^{++}, Co^{++}, Fe^{++}, Mn^{++}, Ce^{3+}, Pr^{3+}, Nd^{3+}, Sm^{+3}, Gd^{3+}, Er^{3+}, Yb^{3+} are calculated and discussed in relation to hydration of ions. C. B. A.

3933. Action of H.F. Alternating Magnetic Field on Suspended Metallic Rings and Discs. P. K. Taylor. *I.R.E., Proc.* 22. *pp.* 886–896, *July*, 1934.—An experimental study of the torque on suspended metallic rings and solid discs caused by a h.f. alternating magnetic field indicates (1) that G. W. Pierce's expression for the torque on a ring is valid over a wide range of frequencies, and (2) that, as a function of frequency, intensity of field, thickness, and conductivity, the torque on a disc is sufficiently similar to that for a ring to suggest that it varies as $\tau p^2 H_v^2/R(1+\tau^2 p^2)$, in which τ is the time constant of the disc, R its effective resistance, and p is 2π times the frequency of the applied magnetic field whose virtual intensity is H_v. Measurement of this torque on a ring or disc apparently constitutes a convenient and practicable method of measuring the intensity of a h.f. magnetic field. Comparative measurements on a ring and disc indicate that the greater part of the induced circular current in a disc at high frequencies flows near its periphery, primarily because of the shielding action of the peripheral currents, a result in agreement with experiments made previously by Zenneck. A reproducible depression in the torque-frequency curve of a thin silver disc was observed at 700 kc. AUTHOR.

3934. Action of Alternating and Moving Magnetic Fields upon Particles of Magnetic Substances. H. S. Hatfield. *Phys. Soc., Proc.* 46. *pp.* 604–609; *Disc.*, 609–610, *Sept.* 1, 1934.—An explanation is offered of the translatory movement observed by Mordey [see Abstract 299 (1929)] in magnetic particles subjected to a multi-phase alternating field. A *Discussion*, to which **S. Chapman** and **S. N. Ray** contributed, concludes the paper. AUTHOR.

3935. Powder Figures on a Magnetised Iron Crystal. S. Kaya. *Zeits. f. Physik*, 89. 11–12. *pp.* 796–805, *July* 13, 1934.—The powder figures produced on a cube face of a magnetised single crystal of iron are examined. Four types of figure are obtained which depend on the degree of magnetisation of the iron crystal. A series of photographs illustrate the various types. It is suggested that the origin of the figures may be traced to the elastic strain set up by the magnetostriction. H. J. H. S.

3936. Gyromagnetic Measurements and their Significance. L. F. Bates. *Nature*, 134. *pp.* 50–51, *July* 14, 1934.—An examination of the present position of this subject. Two effects are described, and attention is directed to the second, namely the production of angular momentum by change in magnetisation. Richardson showed in 1908 that if the magnetic moment of a freely suspended body be changed by an amount M, the angular momentum about the same direction should be changed by an amount U, U/M the gyromagnetic ratio being equal to $2m/e$ on the assumption that the electron is a point charge moving in a closed orbit. Einstein and de Haas verified this result experimentally in 1915 and restated the theory. Since then various investigators have found for ferromagnetic materials values of the factor of m/e approximating to unity. The gyromagnetic ratio is given theoretically by $\frac{1}{g}\,2\,\frac{m}{e}$, where g is the Landé splitting factor which is 1 for purely orbital motion and 2 for spin motion alone. It is concluded that for simple ferromagnetic substances the gyromagnetic ratio is m/e, and for simple paramagnetic substances $\frac{1}{g} 2 \frac{m}{e}$. G. E. A.

3937. Powerful Electromagnet for Birefringence and Atomic Jets. R. Lucas. *Comptes Rendus,* 198. *pp.* 2074–2076, *June* 11, 1934. —The design is given of an electromagnet for the study of birefringence and of atomic jets. The magnet has 5500 turns and uses 4·4 amperes at 120 volts to give a field of 20,000 gauss. The apparatus weighs 1500 kg. and has an air-gap 70 cm. long. With nitrobenzene, the yellow lines of mercury are rotated 12° or about two-thirds of that given by the Bellevue magnet [see Abstract 2795 (1930)]. The heating of the coils is not excessive, and the geometrical design of the apparatus reduces the component of the Faraday effect to one minute of arc. G. E. A.

3938. Pendulum Magnetometer for Crystal Ferromagnetism. L. W. McKeehan. *Rev. Sci. Instruments,* 5. *pp.* 265–268, *Aug.,* 1934.— The quinquefilar pendulum magnetometer of Weiss and Foëx, hitherto used only for substances of small and constant susceptibility (paramagnetic or diamagnetic) has been modified so as to be useful for small ferromagnetic specimens. For these it possesses several advantages over previous magnetometric and ballistic methods. A precise method for cutting small spheroidal specimens for the new magnetometer is described. AUTHOR.

3939. Ballistic Galvanometer Operating in High Vacuum. W. B. Ellwood. *Rev. Sci. Instruments,* 5. *pp.* 300–305, *Aug.,* 1934.— A resonant ballistic galvanometer has been developed especially for precise magnetic flux measurements. The sensitivity is high, 1 mm. deflection at 1 m. scale distance corresponding to 4 Maxwell turns as compared with 500 Maxwell turns for the same deflection in commercial galvanometers. The galvanometer is based upon the principle stated by Maxwell that, if the charge to be measured by a ballistic galvanometer can be sent repeatedly through the galvanometer in proper phase, the amplitude of the swings will increase to a steady value which is proportional to the charge and which is greater the smaller the damping. Operating the moving coil in high vacuum eliminates air damping. A flat tape suspension, thin enough to approach in its properties a simple bifilar suspension, reduces elastic hysteresis. Light from the galvanometer mirror acts on a photoelectric cell controlling the switching mechanism, to ensure the correct timing of the repeated impulses. A high accuracy of integration is attained by reducing to a minimum the eddy currents and hysteresis losses in the galvanometer itself. This is done by avoiding the use of metal in the neighbourhood of the coil. AUTHOR.

See also Abstracts 3498, 3614, 3637, 3812, 3844, 3910.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3940. Methods and Theory of the Normal Human Electrocardiogram. W. Trendelenburg. *Preuss. Akad. Wiss. Berlin, Ber. No.* 5. *pp.* 70–76, 1934.—The original Einthoven electrocardiograph utilised large electrodes for contact with the human subject. As a consequence, skin resistance and polarisation played a considerable part, in respect to the readings obtained. More modern utilisation of the thermiomic valve has removed these difficulties, but, the electrode surfaces used being much smaller, the location of these smaller electrodes introduces variations in respect to their positions relative to the actual heart.

Modes of determining the optimal positions for various examinations are discussed, dependent upon locating the electrode until maximal readings of the electrocardiographic curve are obtained, for various components of the curve. The paper is largely purely medical, but of interest to cardiologists, or others engaged in the use of electrocardiographs. B. J. L.

3941. Kineradiography. R. J. Reynolds. *Brit. J. of Radiology,* 7. *pp.* 415–425, *July,* 1934.—Describes a method of kineradiography in which the image produced on a fluorescent screen is photographed by means of a standard kine-camera of the 16 mm. type. It was found that best results were obtained by the use of modified Ilford SX screens and films coated with X-ray film emulsion. The lens had a special 0·85 short focus made by Zeiss, and was formed of five lenses of which two were sealed together. These were made of glass having spherical surfaces and transmitted light from 3800 Å to 6600 Å. A 20-kW X-ray tube was employed. In order to reduce the load on the tube and to minimise the exposure of the patient, a synchronous switch was used so that the X-ray tube was only excited when the camera shutter was open. With this apparatus exposures of various parts of the human body have been made, including the heart, the thorax and the passage of an opaque meal through the œsophagus, stomach and duodenum. G. E. B.

3942. High-Powered Mobile X-Ray Unit. H. T. Ferrier. *Brit. J. of Radiology,* 7. *pp.* 426–434; *Disc.,* 435–436, *July,* 1934.—A detailed description of a mobile X-ray unit mounted on a car chassis and owned by the British Red Cross and St. John's Ambulance Association. The chassis carries a 7·5-kVA generator, with automatic voltage control and a corresponding X-ray outfit in portable form. When the apparatus is removed, the body of the car is used as a dark room, suitable developing and fixing tanks being provided with thermostatic temperature control. With regard to the generator, the h.t. transformer, control table, tube and tube-stand are taken into the house, and the a.c. current fed by means of waterproof cable from the generator. The *Discussion* mainly centred round the possibility of using shockproof equipment of a form that only the X-ray tube and minor accessories are taken into the house. G. E. B.

3943. X-Ray Standards and Units. *Brit. J. of Radiology,* 7. *pp.* 304–308, *May,* 1934. *Am. J. of Roentgenology and Radium Therapy,* 31. *pp.* 815–818, *June,* 1934. *J. de Radiologie et d'Électrologie,* 18, *pp.* 388–390, *July,* 1934.—Recommendations in relation to the measurement of X-ray quantity and quality, published jointly by the standardisation laboratories of Britain, France, Germany and the U.S.A. B. J. L.

3944. Radium Isodose Curves. E. Stahel. *Brit. J. of Radiology,* 7. *pp.* 437–439, *July,* 1934.—A note on a paper by Goldhaber and Griffith [see Abstract 382 (1934)] concerning isodose curves in the locality of radium containers as measured by an air ionisation chamber. The author shows that the curves agree with those of Sievert and also with some obtained by himself using a liquid ionisation chamber. G. E. B.

3945. Extension of the Statistical Theory of the Biological Action of Rays. Parts I and II. B. Rajewsky and H. Dänzer. *Zeits. f. Physik,* 89. 7–8. *pp.* 412–425, *June* 16, 1934.—The foundations of the statistical theory of the harm-factor (*Schädigungsfaktor*) of radiations with respect to biological objects are discussed. The range of validity of the original theory is extended by generalising the formula which expresses the harm produced. The factor of recuperation is taken into consideration.

In the second part certain well-known assumptions of the theory of probability are used to deal with a special case of the harmful effect of rays on biological objects. H. L. B.

OSCILLATIONS.

3946. Electron Oscillations. J. Müller. *Hochfrequenztechn. u. Elektroakustik,* 43. *pp.* 195–199, *June,* 1934.—An account is given of experimental investigations of electron oscillations generated in specially designed apparatus. The oscillatory circuit consisted of a ring-shaped inductance whose ends were connected to the two plates of a plate condenser. Between the plates was a square flat kathode, heated internally by tungsten spirals and oxide coated. The centre point of the inductance was joined to the positive terminal of a battery, the negative terminal being connected to the kathode. It can be shown that the positive resistance of the oscillatory circuit can be made less than the negative resistance due to the electron stream between the electrodes and hence oscillations may be generated for certain frequency ranges. Theory relating to such an arrangement has previously been given [see Abstract 3855 (1933)]. The oscillations were found qualitatively to have the characteristics to be expected on theoretical grounds. The frequency is determined principally by the oscillatory circuit constants. The wave-length shows a slight decrease with increased anode potential. Quantitatively the results were considerably affected by marked vaporisation of the BaO from the oxide-coated kathode. A slight waviness was observed in the current-potential characteristic and a method is given for quick determination of the second differential of the characteristic. It is estimated that the anode efficiency is about 0·5 %. A. W.

3947. Piezoelectric Stabilisation of High Frequencies. H. Osterberg and J. W. Cookson. *Rev. Sci. Instruments,* 5. *pp.* 281–286, *Aug.,* 1934.—It is shown that moderately thick plates of both quartz and tourmaline may be successfully employed for crystal stabilisation in the frequency range from 5 to 65 megacycles/sec. Specimens which were tested by a beat method exhibited a degree of stability far within that required of commercial broadcast stations. A higher degree of stability was obtained from this thicker type of plate than was obtained from a thin plate which had been ground elsewhere. The applicability of thicker plates was foreseen from the observations that at higher frequency the modes of vibrations of plates of either quartz or tourmaline are not the longitudinal or shear thickness modes, but are rather those in which the longitudinal, flexural, or torsional wave trains are propagated in a more complicated manner throughout the body of the plate. Several of these modes are briefly described. Contrary to the conclusions drawn by Straubel, these experiments indicate that tourmaline does not possess any important advantages over quartz in the stabilisation of high frequencies. Most of the plates could be caused to stabilise at several widely separated frequencies. It is shown that the resonance frequencies of quartz plates are mechanically reproducible even at 60 megacycles/sec. AUTHORS.

3948. Oscillating Valve with Strongly Positive Grid as Thyratron Equivalent. H. Alfvén and P. Ohlin. *Zeits. f. Physik,* 89. 11–12. *pp.* 826–833, *July* 13, 1934.—The thyratron device used by Wynn-Williams [see Abstract 3950 (1932)] as an impulse recorder in a Geiger-Müller counter is modified by using a small receiving valve with a positive grid potential under specified conditions. A simple circuit is described in which the valve, in the oscillating condition, may be used as an impulse counter. The flexibility of the device is great and is easily controlled. The electrical conditions obtaining in the circuit are discussed theoretically. H. J. H. S.

See also Abstracts 3562, 3564, 3846, 3865.

PHOTOELECTRICITY.

3949. Photoelectric Emission of Blocking Layers and the Einstein Relation. G. Liandrat. *Comptes Rendus*, 199. *pp.* 130–131, *July* 9, 1934.—With a Bergmann-Bernheim selenium cell, monochromatic light, and frequency of modulation of 200–300 ∼ the secondary current is eliminated, leaving only the primary current of photoconductivity proportional to the illumination and p.d., and represented by a rectilinear characteristic. The result is therefore in conformity with the Einstein relation. The threshold frequency corresponds to 7900–8100 Å. [See Abstract 2226 (1934).] C. A. S.

3950. Velocity Distribution of Photoelectrons from Thin Metallic Films. E. Wasser. *Phys. Zeits. d. Sowjetunion*, 5. 5. *pp.* 645–658, 1934. *In German.*—An investigation is made into the velocity distribution of electrons liberated photoelectrically in a vacuum from thin films of Pt deposited upon glass, using incident light of wave-lengths 2400 and 2537 Å. It is found that the distribution changes when the platinum film is allowed to stand in the vacuum, the higher velocities becoming more abundant. Possible reasons for this behaviour are discussed. Comparison of the velocity distributions for films of different thicknesses indicates that the Fermi distribution is approached as the thickness is diminished. L. A. W.

3951. Photoelectric Effect in Cuprite Crystals. N. J. Barbaumow, D. L. Schutak and A. F. Ziwtschinsky. *Phys. Zeits. f. Sowjetunion*, 5. 5. *pp.* 666–675, 1934. *In German.*—The e.m.f. developed by illuminating single crystals of cuprite, carefully prepared and mounted with suitable electrodes, is examined and its variation with light intensity studied. The spectral response over the range 500 to 800 mμ is investigated and a maximum response found at 642 mμ. It is shown that it is very difficult to obtain a blocking-layer photoelectric effect with a cuprite crystal. The photoelectric effect varies with the thickness of the crystal in a complicated manner. [See also Abstract 2227 (1934).] H. J. H. S.

3952. Explanation of the Dark Current of Alkali Photoelectric Cells as Thermionic Current. R. Schulze. *Zeits. f. Physik*, 90. 1–2. *pp.* 63–69, *July* 24, 1934.—The dark current in vacuum alkali cells of special construction is measured as a function of the temperature. It is found that at liquid-air temperature none of the alkali metals gives a measurable dark current, but that as the temperature is raised the dark current becomes appreciable and increases according to an exponential law. For the different metals at the same temperature the order of increasing current is Na, K, Rb, Cs. The experiments show that the dark current reaches a saturation value at 2 volts applied potential. This fact, together with the other properties of the current, rules out the possibility of the effect being due to radioactivity. The results are taken as evidence that the dark current of the cells is thermionic in origin. L. A. W.

3953. Metal Contact Photoelectric Cell. P. Selényi. *Physica*, 1. *pp.* 781–782, *July*, 1934. *In German.*—Reference is made to a recent publication by de Boer and van Geel [see Abstract 3062 (1934)] reporting the production of photoelectric currents in cells consisting of an alkali metal separated from a metal plate by a thin layer of insulating material. The author notes that he had previously observed the same effect with the combination Na-NaO-Ni and gives details of the construction of the cells used. L. A. W.

3954. Photoelectric Counters. E. Busse and P. Görlich. *Zeits. f. Instrumentenk.* 54. *pp.* 233–236, *July*, 1934.—Arrangements are described in which a photoelectric cell is used to operate a relay for the purpose of counting objects passing across a light beam. In one of the arrangements a blocking-layer photoelectric cell is used, while in another a device is incorporated to prevent the system from responding to slow variations of illumination due to alterations in daylight intensity, etc. L. A. W.

3955. Photoelectric Absorption. F. Hlučka. *Zeits. f. Physik*, 89. 7–8. *pp.* 497–501, *June* 16, 1934.—In continuation of earlier investigations the hypothesis already set forth that the photoelectric energy transformation in non-conductors with the external photoelectric effect essentially arises only at the kathode surface, is further developed and confirmed by a more extended measurement. J. J. S.

PIEZOELECTRCITY.

3956. Measurement of Strain Ratio in an X-Cut Quartz Crystal. M. Y. Colby and S. Harris. *J.O.S.A.* 24. *pp.* 217–219, *Aug.*, 1934.—An instrument is described which measures the change in thickness of a rectangular crystal to 0·00025 mm. and the change in length to approximately 0·001 mm. The instrument is designed to be used with a crystal of dimensions of 17·5×6×4 mm., the thickness dimension of 4 mm. being parallel to the X axis and the length dimension being parallel to the Y axis; thus a strain as small as 0·00005 along Y and a strain as small as 0·00006 along X can be detected. The ratio of the compressional strain along Y to the extensional strain along X was found to be approximately unity over a fairly wide range of values for the strain along Y. This result is an approximate experimental verification of Voigt's theory of the piezoelectric effect in quartz for static conditions. The device is constructed on a standard Michelson interferometer and a microscope of only medium power is necessary. AUTHORS.

See also Abstracts 3634, 3666, 3947.

THERMIONICS.

3957. Emission of Ions and Electrons from Heated Sources. A. J. Dempster. *Phys. Rev.* 46. *pp.* 165–166, *Aug.* 1, 1934.—It is found that pin-hole photographs may be made of ions or electrons emitted by a heated source. The crossed paths of the charged particles is explained by the space charges in the immediate neighbourhood of the emitting points on the source, which distort the lines of force and allow of accelerations in various directions. Part of the electron emission from an oxide-coated filament and the positive ion emission from spodumene is thus found to be concentrated at definite points on the surface. AUTHOR.

See also Abstract 3564.

THERMOELECTRICITY.

See Abstracts 3790, 3910.